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AMERICAN CONGRESS OF PHYSICAL MEDICINE

September 6, 7, 8, 9, 10, 1949

NETHERLAND PLAZA CINCINNATI, OHIO

VOLUME XXX AUGUST, 1949 NO. 8

INSTRUCTION SEMINAR

In Conjunction with the

27th Annual Scientific and Clinical Session

AMERICAN CONGRESS OF PHYSICAL MEDICINE

September 6, 7, 8, 9, 1949

Netherland Plaza — **Cincinnati, Ohio**

TENTATIVE SCHEDULE

Physicians only may enroll for letter series

TUESDAY MORNING — SEPTEMBER 6	
(A) 10:00-10:50 A.M. Functional Anatomy of Shoulder and Arm Movie Demonstration Parlor H Hollinshead	(B) 11:00-11:50 A.M. Functional Anatomy of Hand Movie Demonstration Parlor H Hollinshead
TUESDAY AFTERNOON — SEPTEMBER 6	
(C) 3:00-3:50 P.M. Therapeutic Exercise: Basic Principles Underlying Parlor H Baker	(D) 4:00-4:50 P.M. Therapeutic Exercise: Neuromuscular Basis for Parlor H Hines
WEDNESDAY MORNING — SEPTEMBER 7	
(E) 8:30-9:20 A.M. Functional Anatomy of Hip and Thigh Movie Demonstration Parlor H Hollinshead	(F) 9:30-10:20 A.M. Functional Anatomy of Lower Leg and Knee Movie Demonstration Parlor H Hollinshead
THURSDAY MORNING — SEPTEMBER 8	
(G) 8:30-9:20 A.M. Movement Patterns in Infants and Children Parlor H Harris	(H) 9:30-10:20 A.M. Movement Patterns in Infants and Children Parlor H Harris
FRIDAY MORNING — SEPTEMBER 9	
(J) 8:30-9:20 A.M. Recent Developments in Physiology of Exercise Parlor H Hellebrandt	(K) 9:30-10:20 A.M. Application of Electrical Principles to Vascular and Cardiovascular Problems Parlor H Jochim

Physicians and qualified technicians may enroll for numbered series

TUESDAY MORNING — SEPTEMBER 6	
(1) 10:00-10:50 A.M. Braces: Anatomic Considerations in Prescribing and Fitting Parlor I Wright	(2) 11:00-11:50 A.M. Special Braces to Favor Functional Activity Parlor I Wright
TUESDAY AFTERNOON — SEPTEMBER 6	
(3) 3:00-3:50 P.M. Electrodiagnosis: Clinical Uses and Interpretation of Golseth-Fizzell Apparatus Parlor I Rose	(4) 4:00-4:50 P.M. Multiple Sclerosis: Evaluation and Prognosis for Physical Rehabilitation Parlor I Kabat
WEDNESDAY MORNING — SEPTEMBER 7	
(5) 8:30-9:20 A.M. Muscular Imbalance: Evaluation and Treatment Parlor I Bennett	(6) 9:30-10:20 A.M. Research in Brace Making Parlor I Young
THURSDAY MORNING — SEPTEMBER 8	
(7) 8:30-9:20 A.M. Cerebral Palsy (Spastic): Diagnosis and Prognosis Parlor I Perlstein	(8) 9:30-10:20 A.M. Cerebral Palsy (Spastic) Patients: Muscle Reeducation Parlor I Perlstein
FRIDAY MORNING — SEPTEMBER 9	
(9) 8:30-9:20 A.M. Development of a Rehabilitation Center Parlor I Covalt	(10) 9:30-10:20 A.M. Muscle Strength Testing: Method, Interpretation and Importance in Evaluation for Rehabilitation Parlor I Knapp

Note: The Committee on Education of the American Congress of Physical Medicine is in charge of the instruction seminar. It is purposely planned to limit the subjects in any year to a few topics, in order to devote enough time to those subjects to give those attending a good review, both from the standpoint of basic knowledge and from the clinical standpoint. Certain groups of these subjects will be repeated every three to five years.

Courses will be offered in two separate groups: One group of ten lectures will be offered on basic subjects and this group will be open only to physicians. A second group of ten lectures will present more general and clinical subjects. Physicians, physical and occupational therapy technicians may register for the second group of lectures. The physical therapy technicians must be registered with the American Registry of Physical Therapy Technecians and the occupational therapy technicians must be registered with the American Occupational Therapy Association. The charge for a single lecture is $2.00, for the full schedule of ten lectures, $15.00.

For full information and application form address

AMERICAN CONGRESS OF PHYSICAL. MEDICINE

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ORIGINAL ARTICLES

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EDITOR OF THE MONTH

FRED B. MOOR, M.D.

Los Angeles, Calif.

Printed in U.S.A.

APPROVED SCHOOLS FOR PHYSICAL THERAPY TECHNICIANS *

Council on Medical Education and Hospitals of the American Medical Association

Name and Location of School	Medical Director and Technical Director	Entrance Requirements*	Duration of Course	Time of Admission	Maximum Enrolment	Tuition	Certificate, Diploma, Degree
Childrens Hospital, Los Angeles[1]	S. S. Mathews, M.D. Miss Sarah S. Rogers	a-b-d	14 mos.	Sept	14	$300	Cert. or Degree
College of Medical Evangelists, Los Angeles[1]	Fred B. Moor, M.D. R. William Berdan	a-b-c	15 mos.	Sept	16	$300	Cert. or Dipl.
University of Southern California, Los Angeles[1]	Charles L. Lowman, M.D. Miss Charlotte W. Anderson	c-d	14-24 mos.	FebSept	20	$569	Cert. or Degree
University of California Hospital, San Francisco[1]	Lucile M. Eising, M.D. Mrs. Margery L. Wagner	d	12 mos.	Sept	16	$220[2]	Cert. or Degree
Stanford University, Stanford University, Calif.[1]	W. H. Northway, M.D. Miss Lucille Daniels	a-b-d	12 mos.	Varies	18	$620	Cert. or Degree
University of Colorado Medical Center, Denver[1]	Harold Dinken, M.D. Miss Mary Lawrence	a-b-d	12 mos.	Sept	12	$300[3]	Cert. or Degree
Northwestern University Medical School, Chicago	John S. Coulter, M.D. Miss Gertrude Beard	a-b-d	12 mos.	Oct	16	$450	Certificate
State University of Iowa Medical School, Iowa City[1]	W. D. Paul, M.D. Mrs. Olive Farr	e	12 mos.	Sept	15	$200	Certificate
University of Kansas School of Medicine, Kansas City[1]	Donald L. Rose, M.D. Mrs. Ruth G. Monteith	a-b-d	12 mos.	FebSept	15	$ 80[3]	Cert. or Degree
Bouvé-Boston School of Physical Education, Boston	Howard Moore, M.D. Miss Constance Greene	H.S.	4 yrs.	Sept	15	$550	Dipl. & Degree
Simmons College, Boston	W. T. Green, M.D. Miss Janet B. Merrill	H.S.-e	1½-4½ yrs.	Sept	25	$550	Dipl. or Degree
Boston University College of Physical Education for Women, Sargent College, Cambridge, Mass.	Kenneth Christophe, M.D. Miss Adelaide McGarrett	H.S.-e-d	1-4 yrs.	Sept	30	$450	Cert. or Degree
University of Minnesota, Minneapolis[1]	M. E. Knapp, M.D. Miss Ruby M. Green	H.S.	4 yrs.	Sept	16	$580[3]	Degree
Mayo Clinic, Rochester, Minn.[1]	Earl C. Elkins, M.D. Miss Helen Belknap	a-e	12 mos.	Sept	30	None	Certificate
Barnes Hospital, St. Louis[1]	Sedgwick Mead, M.D. Miss Beatrice Schulz	c	2 yrs.	Sept	12	$400	Degree
St. Louis University School of Nursing, St. Louis[1]	A. J. Kotkis, M.D. Sister Mary Imelda	H.S.	4 yrs.	JanSept	10	$300	Degree
Albany Hospital, Albany, N. Y.	J. W. Ghormley, M.D. Miss Catherine Graham	a-b-d	12 mos.	Sept	6	$250	Certificate
Columbia University College of Physicians and Surgeons, New York City[1]	William B. Snow, M.D. Miss Floy Pinkerton	a-c-e	1-2 yrs.	Sept	50	$710	Cert. or Degree
New York University School of Education, New York City[1]	George G. Deaver, M.D. Miss Elizabeth Addoms	a[2]-b-d	12 mos.	Sept	40	$600	Cert. & Degree
Duke Hospital, Durham, N. C.[1]	Lenox D. Baker, M.D. Miss Helen Kaiser	a-b-d	15 mos.	Oct	12	$300	Certificate
D. T. Watson School of Physiatrics, Leetsdale, Pa.[1]	Jessie Wright, M.D. Miss Kathryn Kelley	a-b-d	12 mos.	Oct	30	$300	Diploma
Graduate Hospital of the University of Pennsylvania, Philadelphia[1]	George M. Piersol, M.D. Miss Dorothy Baethke	a-b-d	12 mos.	Sept	20	$400	Certificate
University of Texas School of Medicine, Galveston[1]	G. W. N. Eggers, M.D. Miss Ruby Decker	b-d	12 mos.	Jan	8	$163[3]	Certificate
Hermann Hospital, Houston[1]	Oscar O. Selke, Jr., M.D. Mary Elizabeth Kolb	a-b-d	12 mos.	Oct	12	$300	Cert. or Degree
Baruch Center of Physical Medicine of the Medical College of Virginia, in affiliation with Richmond Professional Institute, Richmond[1]	Walter J. Lee, M.D. Miss Susanne Hirt	H.S.-a-b-c-d-e	1-4 yrs.	Sept	54	$275[3]	Dipl. or Degree
University of Wisconsin Medical School, Madison	Harry Bouman, M.D. Miss Margaret A. Kohli	a-b-c H.S.	12 mos. 4 yrs.	FebSept Sept	20 20	$120[3] $120[3]	Certificate Cert. & Degree

* Courses are so arranged that any of the entrance requirements will qualify students for training. a = Graduation from accredited school of nursing; b = Graduation from accredited school of physical education; c = Two years of college with science courses; d = Three years of college with science courses; e = Four years of college with science courses. H.S. = High school graduation.

1. Male students are admitted.
2. R.N. plus one year college.
3. Nonresidents charged additional fee.

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APPROVED SCHOOLS FOR OCCUPATIONAL THERAPY TECHNICIANS *

Council on Medical Education and Hospitals of the American Medical Association

NOTE: The duration of the course is expressed in academic years.

Name and Location of School	College Affiliation	Duration of Course	Classes Start	Entrance Requirements	Tuition Per Year	Certificate, Diploma	Graduates in 1947
University of Southern California, 923½ 35th Place, Los Angeles	University of Southern California	2 yrs.	FebSept	Degree	$420	Certificate	22
		5 yrs.	FebSept	High sch.	$450	Cert.&B.S.	
Mills College, Oakland, Calif.	Mills College	3 yrs.	FebSept	Degree	$200	Certificate	....
					$550		
San Jose State College, San Jose, Calif.	San Jose State College	1½ yrs.	Varies	Degree	$ 21	Certificate	10
		3¼ yrs.	Varies	High sch.	$ 21	Degree	
University of Illinois College of Medicine, 1853 W. Polk St., Chicago	University of Illinois	5 yrs.	Feb	High sch.	$152	B.S.	14
University of Iowa, Iowa City, Iowa	State University of Iowa, College of Medicine	5 yrs.	.....	High sch.	$ 85	Cert.&Deg	
University of Kansas, Lawrence	University of Kansas	2 yrs.	FebSept	Degree	$131	Certificate	10
		4 yrs.	FebSept	High sch.	$131	B.S.	
Boston School of Occupational Therapy, 7 Harcourt St., Boston	Tufts College	2 yrs.	Sept	Degree	$500	Diploma	13
		5 yrs.	Sept	High sch.	$450	B.S.	
Wayne University, 4841 Cass, Detroit, Mich.	Wayne University, College of Med., Coll. of Liberal Arts, Coll. of Education	5 yrs.	.....	High sch.	.....	.....	
Kalamazoo School of Occupational Therapy, Western Michigan College of Education, Kalamazoo	Western Michigan College of Education	1½ yrs.	FebSept	Degree	$127	Diploma	20
		4 yrs.	FebSept	1 yr. coll.	$127	Degree	
Michigan State Normal College, Ypsilanti	University of Michigan	5 yrs.	Varies	High sch.	$118	Cert.&Deg.	8
University of Minnesota, Church Street, Minneapolis	University of Minnesota	4 yrs.	.....	High sch.	$360	B.S.	
College of St. Catherine, St. Paul, Minn.	The College of St. Catherine	3½ yrs.	Varies	1 yr. coll.	$210	Degree	4
Washington University School of Medicine, St. Louis	Washington University	3 yrs.	Sept	2 yrs. coll.	$400	Degree	10
University of New Hampshire, Durham	Univ. of New Hampshire	5 yrs.	Sept	High sch.	$160	Cert.&Deg.	6
Columbia University College of Physicians and Surgeons, 630 W. 168th St., New York City	Columbia University	1½ yrs.	Sept	Degree	$450	Certificate	28
		2½ yrs.	Sept	2 yrs. coll.	$450	Degree	
New York University School of Education, 100 Washington Sq. E., New York City	New York University	4½ yrs.	FebSept	High sch.	$500	Cert.&Deg.	20
Ohio State University, Columbus	Ohio State University	3 yrs.	Quarterly	High sch.	$105	Degree	21
Philadelphia School of Occupational Therapy, 419 S. 19th St., Philadelphia	University of Pennsylvania	1½ yrs.	Sept	Degree	$500	Diploma	35
		3 yrs.	Sept	1 yr. coll.	$500	Diploma	
		.....	.....	High sch.	$600	.....	
Texas State College for Women, Denton, Tex.	Texas State College for Women	5 yrs.	FebSept	High sch.	$150	Degree	13
Richmond Professional Institute, 901 W. Franklin St., Richmond, Va.	Medical College of Virginia	1½ yrs.	Sept	Degree	$200	Certificate	20
		3 yrs.	Sept	1 yr. coll.	$200	Certificate	
College of Puget Sound, Tacoma, Wash.	College of Puget Sound	3 yrs.	FebSept	Degree	$350	Certificate	
		5 yrs.	FebSept	High sch.	$300	Cert.&Deg.	
University of Wisconsin, Madison	University of Wisconsin	4 yrs.	FebSept	High sch.	$320	Cert.&Deg.	8
Milwaukee-Downer College, Dept. of Occupational Therapy, 2512 E. Hartford, Milwaukee	Milwaukee-Downer College	2½ yrs.	Sept	1 yr. coll.	$300	Diploma	22
		4 yrs.	Sept	High sch.	$300	Dipl.&Deg.	
Mount Mary College, 2900 Menomonee River Dr., Milwaukee		Varies	Sept	Degree	$335	Certificate	15
University of Toronto, Dept. of University Extension, Toronto, Ont., Canada	University of Toronto	5 yrs.	Sept	High sch.	$260	B.S.Deg.	
		3 yrs.	Sept	1 yr. coll.	$222	Diploma	110
Colorado Agricultural and Mechanical College, Fort Collins, Colorado		5 yrs.	Sept	High sch.	.....	B.S.	

* Rep. in part J. A. M. A. 137:1460 (Aug.) 1948.

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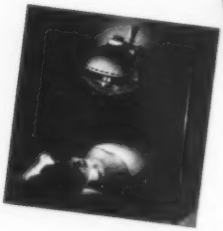

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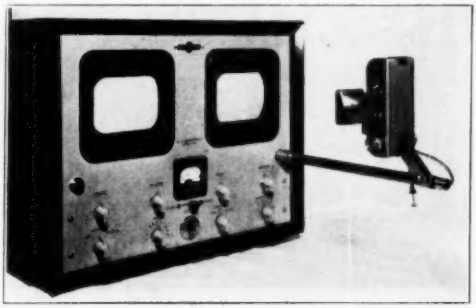
ELECTROMYOGRAPHIC DIAGNOSIS OF LOWER MOTOR NEURON DISEASE *

JAMES G. GOLSETH, M.D.
PASADENA
and
O. LEONARD HUDDLESTON, M.D., Ph.D.
SANTA MONICA

Electromyographic diagnosis of lower motor neuron disease is based on one simple but fundamental principle, namely, that normal and abnormal voluntary muscles generate voltages having different characteristics. In order to study the characteristics of muscle voltages accurately, it is first necessary to elicit them from the muscle by means of a needle electrode in the muscle. Next, these voltages must be amplified many times and then converted into visible patterns by means of a cathode ray oscilloscope. In addition, it is frequently desirable to listen to the audible sound or noise they produce by means of a loud speaker. The instrument which elicits, amplifies and converts the muscle voltage into visible patterns and sound energy is called an electromyograph, and the permanent record of the muscle voltages



Electromyograph, consisting of amplifiers, cathode ray oscilloscope, loud speaker and camera.

which is obtained by photographing the cathode ray oscilloscope is called an electromyogram.

Normal voluntary muscle in a completely relaxed state generates no voltages of sufficient magnitude to be recorded by the electromyograph. In other words, a normal muscle which is completely relaxed is also an electrically silent muscle from the electromyographic standpoint. Normal voluntary muscle which is made to contract as a result of either volitional or reflex effort generates voltages which are termed "normal motor unit voltages." A motor unit has been defined by Denny-Brown and Pennybacker[1] as a functional unit consisting of one anterior horn cell, its axon and its dependent group of muscle fibers. The motor units of mammalian muscles contain from 100 to 160 muscle fibers, and, according to Clark,[2] the motor units of muscles

* From the Departments of Physical Medicine of the University of Southern California Medical School and the Los Angeles County General Hospital, Los Angeles, California.
* Read before the Neurology Section at the Seventy-Seventh Annual Session of the California Medical Association, San Francisco, April 12, 1948.
* Aided by a grant from the National Foundation for Infantile Paralysis, Inc.
1. Denny-Brown, D., and Pennybacker, J. B.: Brain **61**:311, 1938.
2. Clark, D. A.: Am. J. Physiol. **96**:296, 1931.

responsible for delicate movements contain relatively fewer muscle fibers than do those of muscles responsible for more gross movements. However this may be, the muscle fibers of a given normal motor unit appear to contract synchronously in response to excitation of the motor nerve, and, as a result of the spread of the contraction wave, a simple (monophasic, diphasic or triphasic) voltage is generated.

Normal motor unit voltages range in magnitude from about 100 to 2,000 microvolts and are readily elicited from all areas of a contracting normal muscle. The duration of a single wave is in the order of 5 to 10 milliseconds, and the repetition frequency varies from about 5 to 30 per second, depending on the force of contraction. Because of their simple wave form and relatively long duration, normal motor unit voltages produce a very characteristic thumping noise in the loud speaker.

When voluntary muscle has been deprived of its nerve supply for various periods of time, depending on the species, the individual denervated muscle fibers begin to twitch in a rhythmic manner. This rhythmic twitching of denervated muscle has been termed denervation fibrillation, and, according to Denny-Brown and Pennybacker,[1] results when the denervated muscle fibers become sensitized by neural atrophy to small amounts of acetylcholine in the normal circulation. Although Schiff[3] in 1851 observed and described denervation fibrillation in the tongue musculature of dogs following section of both hypoglossal nerves, the voltages generated by fibrillating denervated muscles were first recorded by Schaffer and Licht[4] in 1926. Brown[5] measured these voltages more accurately in 1937 and concluded from his studies that the spontaneous fibrillation voltages are to be attributed to the activity of single muscle fibers. Since the term denervation fibrillation denotes the contractions of individual muscle fibers, it is of great importance to note that true denervation fibrillation cannot be observed through the intact skin. In order, therefore, to detect and prove its presence in a muscle, it is necessary to employ electromyography. The voltages generated by fibrillating denervated muscles are termed denervation fibrillation voltages and range in magnitude from about 5 to 100 microvolts. They usually have a diphasic wave form, and their repetition frequency varies from about 2 to 30 per second. A single wave has a duration of only 1 to 2 milliseconds, and, because of its extremely short duration, a fibrillation voltage produces a very characteristic clicking noise in the loud speaker.

When a denervated muscle becomes reinnervated — that is, when it again acquires nerve substance through regeneration of its own nerve — it generates motor unit voltages which are highly polyphasic or complex in wave form. Because Weddell and associates[6] observed these highly complex motor unit voltages in muscles during the early stages of reinnervation after peripheral nerve lesion, they designated them as "nascent" (meaning newborn) motor unit action potentials or voltages. In a later communication, these investigators[7] stated that they believed the term "nascent" to be an inaccurate one because they thought it theoretically possible to have highly polyphasic or complex motor unit voltages during the course of demyelinating diseases. In a previous communication, we[8] pointed out that complex motor unit voltages are frequently elicited from "polio" muscles one to two months after the onset of the disease. In addition, we have observed complex motor voltages to be a constant finding in such degenerative diseases as amyotrophic lateral sclerosis

3. Schiff, M.: Arch. f. d. Physiol, Heilk **10**:579, 1851.
4. Schaffer, H., and Licht, H.: Arch. f. Exper. Path. u. Pharmakol. **115**:180, 1926.
5. Brown, G. L.: J. Physiol. **89**:438, 1937.
6. Weddell, G.: Feinstein, B., and Pattle, R. E.: Lancet **1**:236, 1943.
7. Weddell, G.: Feinstein, B., and Pattle, R. E.: Brain **67**:178, 1944.
8. Huddleston, O. L., and Golseth, J. G.: Arch. Phys. Med. **29**:92, 1948.

and progressive muscular atrophy. Because of these facts, we believe that highly polyphasic or complex motor unit voltages are abnormal electromyographic phenomena and, as such, may represent early nerve degeneration as well as early nerve regeneration. It was mentioned previously that the muscle fibers of a normal motor unit contract synchronously, thus producing a simple or diphasic voltage. The muscle fibers of an abnormal motor unit, on the other hand, contract asynchronously, thus producing a complex or highly polyphasic voltage. Although on purely theoretical grounds, there are numerous conditions which could give rise to the asynchronous contractions of the muscle fibers of an abnormal motor unit, the explanation offered by Weddell and associates[7] for such asynchronism appears very logical. These workers have demonstrated great variations in the diameters of the preterminal axons and also of the axonal elements of the motor end plates during nerve regeneration. Because of this observation, it appears likely that the asynchronous contractions of the muscle fibers of abnormal motor units are caused by variations in conduction rates in the preterminal axons of such motor units or by variations in the latent period at the myoneural junctions.

Complex or abnormal motor unit voltages range in magnitude from about 10 to 1,500 microvolts. Their repetition frequency varies from about 2 to 30 per second, and the duration of a single wave group is usually in the order of 5 to 15 milliseconds. Because of the complexity of these waves, abnormal motor unit voltages give rise to a very rough sounding noise in the loud speaker.

The clinical neurologist usually associates fibrillary twitchings with such degenerative diseases as amyotrophic lateral sclerosis and progressive muscular atrophy. The electromyographist, however, prefers to designate such visible involuntary contractions as fasciculations and reserves the term fibrillation for the invisible involuntary contractions of completely denervated muscle. According to Denny-Brown and Pennybacker,[1] fascicular twitches are the response of single motor units to stimuli arising presumably anywhere along the course of the lower motor neuron. These investigators inferred, however, that fasciculations arise from the anterior horn cells and concluded that fibrillations arise at the myoneural junctions. More recent work by Forster, Barkowski and Alpers[9] indicates that fasciculations do not arise at the anterior horn cells, since they are present for a time after denervation of fasciculating muscle. To prove this fact, these workers sectioned the nerves of patients having severe amyotrophic lateral sclerosis and found that the muscles continued to fasciculate for approximately ten days after sectioning of their nerve supply. Of particular interest to us, however, is the fact that fasciculating muscles generate motor unit voltages of complex wave form when the fasciculations are the result of lower motor neuron disease.

Up to this time, we have attempted to point out the electromyographic differences between normal, denervated and partially denervated voluntary muscles. We shall next discuss the application of these differences in lower motor neuron disease.

During World War II there was a great need for an instrument such as the electromyograph which would aid in differentiating a physiologic interruption of a nerve from an actual severance of the nerve. It was our experience, as well as that of others, that a physiologic interruption was usually not complete in the electromyographic sense, even though the clinical ex-

9. Forster, F. M.; Barkowski, W. J., and Alpers, B. J.: Arch. Neurol. & Psychiat. 56:276, 1946.

amination revealed a complete loss of motor and sensory function. In most instances of physiologic interruptions, a few motor unit voltages could be elicited if a thorough sampling of the muscles supplied by the nerve was executed, whereas no motor unit voltages could be elicited if there was an actual severance of the nerve. If, on the other hand, no motor unit voltages could be elicited on attempted voluntary effort, but similarly little or no denervation fibrillation was elicited eighteen to twenty-one days after the injury, one could state with reasonable accuracy that the lesion was a physiologic interruption and not an actual severance. The electromyograph also proved very valuable for following cases after nerve sutures. Usually the first return of motor unit activity preceded the first return of functional recovery by one to several months, and, in addition, the time required for the spread of motor unit activity throughout a muscle gave a good index relative to the progress of reinnervation and the ultimate functional recovery to be anticipated. For example, it was shown by one of us[10] in the experimental animal that, when beginning motor unit recovery was used as a sign of reinnervation, the rate of reinnervation ranged from 2.52 to 2.96 mm. per day, with a mean of 2.21 mm. per day. When, on the other hand, a detectable movement of the muscle was used as the first sign of reinnervation, the rate of innervation was found to range from 1.8 to 2.6 mm. per day, the mean being 2.02 mm. per day. In other words, the rate of reinnervation as measured by the electromyograph was approximately 0.6 mm. per day faster than the rate of reinnervation as measured by clinical methods.

We[8] have recently reported the significance of denervation fibrillation in paretic and paralyzed "polio" muscles. In this investigation it was found that a high percentage (81.2 per cent) of "polio" muscles, having nothing but denervation fibrillation twenty-one to sixty days after the onset of the disease, did not recover any motor power one year later. Of the group of muscles having widespread fibrillation and motor unit activity between the twenty-first and fortieth postonset days, only 38.4 per cent showed a significant increase in power when examined one year later, whereas 61.6 per cent of them either remained the same or showed a significant decrease in power at the later date. It would appear, therefore, from this evidence, that when sufficient damage has been inflicted on the cell of a motor unit to produce denervation fibrillation in its dependent group of muscle fibers, this cell is not capable of regenerating another axon to these muscle fibers. In other words, when the changes in the anterior horn cell have been sufficient to produce wallerian degeneration in the axon, these changes in the cell appear to be irreversible.

Rather recently Hoefer and Guttman[11] have employed electromyography for determining the level of lesions in the spinal cord. From this study, they conclude that motor unit discharges (fasciculations) recorded from relaxed muscles may indicate the level of a lesion of the spinal cord, even in the absence of clinical manifestations suggestive of involvement of the region of the anterior horn cells or the motor roots. In 17 of their 24 cases the structural lesion was satisfactorily localized by this method, and in only 2 cases were false localizations made. Brazier, Watkins and Michelson[12] reported the results of a study on 10 cases of suspected compression of the nerve roots by protruding intervertebral disks. In 9 of the 10 cases the electromyographic localization of the segmental involvement was confirmed by surgical intervention and in the tenth by myelographic studies. In 2 cases of suspected

10. Golseth, J. G., and Fizzell, J. A.: Am. J. Physiol. **150**:558, 1947.
11. Hoeffer, P. F. A., and Guttman, S. A.: Arch. Neurol. & Psychiat. **51**:415, 1944.
12. Brazier, M. A. B.; Watkins, A. L., and Michelson, J. J.: Arch. Neurol. & Psychiat. **56**:651, 1946.

ruptured disk with having equivocal roentgenographic findings but normal electromyograms, subsequent laminectomy failed to reveal the presence of a protruding intervertebral disk in either case. These same workers have also found the fasciculation voltages accompanying a degenerative process of the anterior horn cell to have different characteristics from those accompanying axonal lesions, such as root compression and the neuritides. In cases of progressive muscular atrophy and amyotrophic sclerosis, the fasciculation voltages exhibit great variations in magnitude and repetition frequency and, in addition, are usually complex. The magnitudes and repetition frequencies of fasciculation voltages accompanying axonal lesions, on the other hand, are usually more constant, and, furthermore, these voltages usually have a simple or diphasic wave form.

In previous paragraphs we have discussed the characteristic voltages generated by normal and abnormal voluntary muscles and, in addition, have mentioned briefly some of the commoner conditions under which abnormal electromyograms are obtained. At this time it should be emphasized that denervation fibrillation is a phenomenon characteristic of completely denervated muscle, and, for this reason, denervation fibrillation voltages are not elicited from a muscle unless there has been severe damage to its nerve supply. In other words, it is impossible for a person to control the presence or absence of denervation fibrillation in his muscles just as it is impossible for him to control the wave form of the motor unit voltages generated by his muscles. Because of these facts, the electromyograph affords an objective test for assessing the functional integrity of the final common path, and, because of its objectiveness, it is proving itself to be invaluable in medicolegal work for differentiating among lower motor neuron disease, hysteria and malingering.

In this communication we have attempted to present very briefly the subject of electromyographic diagnosis of lower motor neuron disease. We sincerely trust that we have not left this group of neurologists with the impression that we regard the electromyograph as a machine into which one has simply to drop a nickel and listen to the diagnosis over the loudspeaker. Electromyography does not and never will replace a careful neurologic examination. Since, however, electromyographic diagnosis is based on fundamental physiologic principles, it is our belief that additional information concerning neuromuscular disorders can frequently be obtained when electromyography is done in conjunction with a careful neurologic examination.

Discussion

Dr. Nicholas A. Bercel (Los Angeles): Clinical medicine has its limitations, which are the limitations of the sense organs of the clinician. The electronic amplification and modern high fidelity recording devices have extended enormously the range of methods of observation. It is probably no overstatement that the myopathies belong to one of the most underprivileged branches of internal medicine. Our knowledge of the metabolism of muscles is still incomplete. Considering the important role that the motor apparatus plays in our daily existence, this stepchild status is deplorable.

It follows automatically that any clinical investigating method of a nature to throw more light upon the intricacies of muscle physiology is sorely needed. The electromyogram is just such a tool.

Even though it was known for almost a century that the intrinsic electrical activity of striated muscle has abnormal characteristics in diseases of the lower motor neuron, we had to wait until the introduction of electronic devices in our laboratory before the science of electromyography as we know it today was born. Most of what you have heard was discovered during the past twenty years.

Thus in the potentials associated with denervation fibrillation we learned to recognize one of the most reliable pathognomonic signs of clinical medicine. The electromyographer goes after this sign with the tenacity of a bulldog, and, if it does not appear spontaneously, he will warm up the muscle or will try to bring it out by injection of neostigmine, which by keeping the acetylcholine from destruc-

tion by its estherase, will give it a chance to achieve its action on the sensitized muscle at the motor-nerve junction. The significance of spontaneous motor unit discharges is not as absolute as that of fibrillation potentials, but they can be interpreted satisfactorily with a little experience.

The assistance that electromyography can furnish in medicolegal matters and in the differential diagnosis of paralysis due to axonal interruption from reversible ischemic block cannot be overemphasized. Since expanding cord lesions may as easily arise around the motor as around the sensory roots and since it takes a longer time for such a lesion to cause motor symptoms than sensory manifestations, electromyographic information may afford the surgeon to operate much earlier.

Electromyography, as was stated by the speaker, is one branch of medicine which has greatly profited from the war, which always generously delivers its load of peripheral nerve lesions. The bulk of progress was achieved by a handful of eager researchers in this country and in England. Dr. Golseth belongs to this group.

In closing, may I state that the authors have performed a real service to this section by presenting in crystal clear language the essentials of everyday electromyography with the unusual competence of a man who is equally at home in neurology and in electronics.

Dr. Bertram Feinstein (San Francisco): Dr. Golseth and Dr. Huddleston are to be congratulated on this interesting and lucid paper. They have presented the salient features of electromyography and indicated its usefulness in diagnosis of lesions of the lower motor neuron. This type of examination is of particular value in peripheral nerve lesions, for it gives a definite indication whether or not the axon has been interrupted. It is important to be able to form an opinion of the type of lesion, not only for diagnosis and treatment but for prognosis as well. I should like to comment on a few of the points that are of some importance clinically.

There is some question concerning the length of time that denervated muscle may fibrillate. Fibrillation may be observed as long as muscle tissue is present. In one instance, for example, fibrillation action potentials were recorded from the paralyzed facial musculature of a man aged 45 who sustained his paralysis at birth.

It is sometimes difficult to elicit fibrillation action potentials in a muscle suspected of being denervated. This activity can frequently be enhanced by warming the tissue by means of radiant heat. It has been shown experimentally that warming increases and cooling decreases fibrillation. Indeed, it is possible actually to inhibit the activity by cooling. The mechanism concerned here is probably variation in tissue metabolism. Another useful method of eliciting fibrillation in clinical work is by the administration of prostigmine. Dr. Golseth pointed out that the stimulating factor of fibrillation activity is probably the acetylcholine in the tissues. It is well known that denervated muscle has an increased sensitivity to drugs. Neostigmine, acting at the neuromuscular junction, presumably prevents the destruction of acetylcholine and so "potentiates" its action.

The action potentials mechanically stirred up by insertion of the needle electrodes are frequently of some value in diagnosis. In paralysis due to a reversible physiologic block, such as Bell's palsy, crutch palsy, etc., insertion of the needle electrode into the paralyzed muscle elicits a short outburst of motor unit action potentials but no sustained activity of any type. In these instances, as long as no fibrillation is present, it may be assumed that the axons are intact. If no electrical activity can be elicited upon insertion of a needle electrode, morphologic changes — that is, fibrosis — may have occurred.

In closing, I should like to echo Dr. Golseth's comment: "electromyography is a useful adjunct to a careful clinical examination."

THE INFLUENCE OF ATROPINE ON THE EFFECTS OF MECHOLYL ION TRANSFER ON THE PERIPHERAL CIRCULATION IN MAN *

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The vasodilating effects of mecholyl have been known for a long time. Kovács and Kovács,[1] in 1934, applied mecholyl by ion transfer and noted redness of the skin, increase in skin temperature of 4 to 10 degrees F. (2.2 to 5.5 degrees C.), increase in rate of capillary flow and increase in oscillometric readings. These findings were considered to be due to arteriolar dilatation. Goldsmith[2] found that mecholyl in doses of 50 to 1,500 mg., when given by mouth to patients with vascular disease, produced an average maximal rise in skin temperature of 5.82 degrees C. The clinical observations, such as flushing of the skin[3] and increase in skin temperature,[4] were attributed to the vasodilatory effect of mecholyl.

Montgomery and his co-workers,[5] from observations made with the aid of the venous occlusion plethysmograph, reported that mecholyl, when applied by ion transfer to the hand, caused a significant increase in blood flow in the hand, both of normal subjects and of patients who had peripheral vascular disease. Abramson and his associates,[6] who also used the venous occlusion plethysmograph to study the effect of mecholyl ion transfer obtained increases in the blood flow of the forearm, leg and foot when these areas were treated with mecholyl. They also demonstrated that the predominant effect of mecholyl was on the cutaneous circulation. Hertzman and Dillon[7] and Randall and Hertzman[8] studied the flow in the skin of the toes, legs and forearms with the aid of the photoelectric plethysmograph and found that the introduction of mecholyl by ion transfer increased the circulation.

* Read at the Twenty-Sixth Annual Session of the American Congress of Physical Medicine, Washington, D. C., Sept. 8, 1948.

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7. Hertzman, A. B., and Dillon, J. B.: Applications of Photoelectric Plethysmography in Peripheral Vascular Disease, Am. Heart J. **20**:750 (Dec.) 1940.

8. Randall, W. C., and Hertzman, A. B.: The Effects of Mecholyl Iontophoresis and of Reflex Thermal Dilatation on the Cutaneous Blood Flow, Federation Proc. **3**:38, 1944.

Raymond-Hamet[9] reported that the intravenous or intra-arterial injection of atropine into the dog often produced marked increases in blood flow. In the human being, however, atropine when given in therapeutic doses, only occasionally produces cutaneous vasodilatation.[10]

Some of the effects produced by the introduction of cholinergic drugs into the body may be prevented by atropine. Dale and Gaddum[11] found that atropine prevented the production by acetylcholine of contractures in the frog. In the cat, atropine will stop the lacrimation, salivation, vomiting and diarrhea produced by mecholyl.[12] In this animal, the fall in blood pressure produced by the intravenous injection of mecholyl is partly or entirely prevented by atropine.[12] Bülbring and Burn[13] gave evidence for the annulling effect of atropine on the vasodilatation produced by cholinergic substances. They observed that stimulation of the lumbar sympathetic chain caused a fall in blood pressure and an increase in the volume of the hindlimb of the anesthetized and eviscerated dog, provided that epinephrine had been injected prior to the stimulation. This fall in blood pressure produced by stimulation of the sympathetic fibers to the lower extremity when epinephrine was present was enhanced by the injection of eserine and abolished by atropine. These authors suggested that atropine was antagonistic to a cholinergic substance liberated on stimulation of the sympathetic fibers.

Halméjac and Haimovici[14] measured the change in volume of the hindlimb of the anesthetized dog following various procedures. If the femoral artery was occluded for three seconds and then released, there was a large increase in the volume of the limb. If 3 mg. of eserine was injected intra-arterially twenty minutes before occlusion of the femoral artery, the increase in the volume of the limb was of greater duration than by occlusion alone. When atropine was injected intra-arterially, however, occlusion of the femoral artery resulted in only a small increase in the volume of the limb. These findings were interpreted as indicative of the liberation of a vasodilator substance during the abrupt fall in blood pressure. Furthermore, this vasodilating substance was antagonized by atropine.

Much of the evidence concerning the antagonistic effect of atropine on the vasodilating properties of the cholinergic drugs seems to be indirect. This is especially true with regard to the peripheral circulation. Results obtained from anesthetized animals may not apply to the normal unanesthetized human being. Furthermore, blood pressure readings and measurements of the volume of the limb do not necessarily indicate the state of tone of the arterioles of the extremities.[15] This study was carried out on man in order to determine the effect of atropine on the changes in the peripheral circulation produced by mecholyl ion transfer.

Method

The source of the direct current used for ion transfer was a commercial model muscle stimulator approved by the Council on Physical Medicine of the American Medical Association. The cathode, used in this study as the inactive electrode, was 5½ by 7¾ inches (14.0 by 19.7 cm.), (42.6 square inches, or 275.8 sq. cm.). This elec-

9. Raymond-Hamet: Sur le mécanisme de l'action vasodilatatrice de l'atropine, Compt. rend. Soc. de biol. **122**:42 (May 2) 1936.
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13. Bülbring, Edith, and Burn, J. H.: Cholinergic Nature of Sympathetic Vaso-Dilator Fibres, J. Physiol. **81**:42P (May 12) 1934.
14. Halméjac, J., and Haimovici, H.: Sur les fibres vaso-dilatatrices cholinergiques des membres postérieurs du chien, Compt. rend. Soc. de biol. **122**:226 (April 3) 1936.
15. Abramson, D. I., and Ferris, E. B.: Responses of Blood Vessels in the Resting Hand and Forearm to Various Stimuli, Am. Heart J. **19**:541 (May) 1940.

trode was applied to the back, separated from the skin by asbestos paper soaked in isotonic saline solution. The anode, or active electrode, was applied to the left forearm. In most of the studies a strip of asbestos 6 inches (15 cm.) wide was wound around the forearm to cover an area of about 57 square inches (367.7 sq. cm.) and a strip of Crooke's metal 1¼ by 19½ inches (3.2 by 49.5 cm.) was wound around the asbestos. In a few observations the anode was 5¼ by 3¾ inches (19.7 square inches, or 127.1 sq. cm.). In most of the observations the asbestos paper at the anode was soaked in 1:200 solution of mecholyl. In order to determine the effect of the passage of the direct current, a few studies were performed with the asbestos at the anode soaked in isotonic saline solution instead of mecholyl.

The studies on blood flow were made by means of the venous occlusion plethysmograph with the compensating spirometer recorder.[16] In order to determine the blood flow in the lower extremity, the foot and leg to 1 inch below the tibial tuberosity were inserted into the plethysmograph. In some studies the blood flow of the upper extremity was determined by inserting the hand, forearm and distal part of the arm to 1 inch above the oleocranon process into the plethysmograph. In other observations a shorter plethysmograph was used, so that only the forearm and distal part of the arm to 1 inch above the olecranon process were within the chamber. During the determination of the blood flow in the forearm the hand was excluded by a pressure of 300 mm. of mercury at the wrist.[17]

Eighty-one observations were made on 23 human subjects who agreed to the study. Control values for blood flow were established after each subject had been lying quietly for at least half an hour in a room whose temperature did not vary during the period of observation. The heart rate was recorded at regular intervals in order to establish a steady control value. Ion transfer then was given to the left forearm for a period of thirty minutes, and the heart rate was recorded at regular intervals during ion transfer. For some studies atropine was injected subcutaneously or intravenously before ion transfer. For others atropine alone was given in order to determine its effect on the circulation. After the procedure the blood flow and heart rate were determined again. The blood pressure was determined before and after the ion transfer or injection of atropine by the usual clinical method with the mercury manometer in some instances. Three groups of observations were made.

Group 1. — Forty-eight observations were made on 12 subjects in this group. The blood flow in all four extremities was studied. In this group blood flow was measured in the hand and forearm of both upper extremities and in the foot and leg of both lower extremities. After the control values of blood flow were established, ion transfer was given to the left forearm for thirty minutes; the blood flow was again determined in all four extremities five minutes after ion transfer was stopped. Four such observations were made on each of the 12 subjects. The procedure in the four sets of observations varied as follows:

1. To determine the effect of the direct current itself, the anode (19.7 square inches) was soaked in isotonic saline solution. A current of 30 ma. was used.
2. The anode was soaked in a 1:200 solution of mecholyl instead of saline solution. The anode area and the strength of the current were the same as in the first procedure.
3. Again the solution at the anode was 1:200 mecholyl, but this time the anode was larger (approximately 57 square inches) and the strength of the current was reduced to 20 ma.
4. In order to determine the effect of atropine, 1/100 grain (0.00065 Gm.) of atropine sulfate was injected subcutaneously fifteen minutes before the application of ion transfer in the same manner as in the third procedure. In addition to the control blood flow readings and the readings taken five minutes after ion transfer was stopped, readings were made ten minutes after the injection of atropine.

Group 2. — Eighteen observations were made on 6 subjects in this group. The blood flow was studied only in the upper extremities. The hand and the forearm were inserted into the plethysmograph, and the control values for blood flow were established. Five, twenty, forty and sixty minutes after mecholyl ion transfer to the left forearm or intravenous injection of atropine or both, additional readings of blood flow were taken. Three observations were made on each subject. The procedure in this group varied as follows:

1. To determine the effect of mecholyl alone the large anode (57 square inches) was soaked in 1:200 solution of mecholyl and applied for thirty minutes with a current of 20 ma.

16. Berry, M. R.; Baldes, E. J.; Essex, H. E., and Wakim, K. G.: A Compensating Plethysmokymograph for Measuring Blood Flow in Human Extremities, J. Lab. & Clin. Med. 33:101 (Jan.) 1948.
17. Abramson, D. I.: Vascular Responses in the Extremities of Man in Health and Disease, Chicago, University of Chicago Press, 1944, pp. 62-63.

2. To determine the effect of atropine alone, 1/200 grain (0.00032 Gm.) of atropine sulfate was injected intravenously.

3. To determine the effect of atropine on the circulatory change produced by mecholyl, 1/200 grain (0.00032 Gm.) of atropine sulfate was injected intravenously five minutes before ion transfer was applied as in the first procedure in this group.

Group 3. — Fifteen observations were made on 5 subjects. In this group the hand was excluded by a pressure of 300 mm. of mercury at the wrist, so that only the flow in the forearm was recorded. Three studies were performed on each subject. The procedures were the same as in group 2. Blood flow of the forearms was taken five, forty and sixty minutes after the application of mecholyl ion transfer to the left forearm was stopped or after the injection of 1/200 grain (0.00032 Gm.) of atropine sulfate intravenously or after both procedures (mecholyl ion transfer preceded by atropine, given intravenously).

Results

Group 1 (tables 1 and 2). — When the anode was soaked in isotonic saline solution for the purpose of determining the effect of direct current on the blood flow, the following changes occurred. The blood flow of the treated extremity increased an average of 14 per cent, with a range of change from —3 to +49 per cent. In the contralateral untreated upper extremity there was an average decrease in blood flow of 15 per cent, with a range from —38 to +11 per cent. The average changes in the blood flow in the lower extremities were insignificant — namely, —4 per cent in the left lower extremity and +3 per cent in the right lower extremity. There was no significant change in pulse rate; the average rate before treatment was 71 beats per minute and after treatment 70. The blood pressure showed no significant changes; it averaged 112 mm. of mercury systolic and 69 mm. diastolic before ion transfer and 116/72 after it.

When the small anode was soaked in 1:200 solution of mecholyl, and ion transfer was given with the small anode as the saline ion transfer was, the average increase in blood flow in the treated extremity (left forearm and hand) was practically the same as with the saline ion transfer — namely, 12 per cent, with a range of change from —33 to +82 per cent. The changes in blood flow in the untreated extremities also were insignificant — namely, —4 per cent in the right upper extremity, —14 per cent in the left lower extremity and — 13 per cent in the right lower extremity. There was a significant increase in the average pulse rate during ion transfer from 67 to 80 per minute. There was only a slight and insignificant change in the average blood pressure from the control value of 113/70 to 110/67 during ion transfer. Of the 12 subjects, 9 had a fall in blood pressure, 2 a rise and 1 no change.

When mecholyl was applied to the left forearm by means of the large anode (57 square inches) and a current of 20 ma., much larger increases in blood flow were produced in the treated extremity — namely, 31 per cent, with a range of change from —17 to +62 per cent. The average changes in blood flow in the untreated extremities were —9 per cent in the right upper extremity, —2 per cent in the left lower extremity and +3 per cent in the right lower extremity. The pulse rate increased during ion transfer from an average of 69 to 74 beats per minute. The changes in blood pressure were not significant. The average control pressure was 112/69 and during ion transfer it was 112/66.

To determine the effect of atropine, 1/100 grain of atropine sulfate was injected subcutaneously fifteen minutes before beginning the ion transfer, which was applied with the large anode and a current of 20 ma. There was practically no change in the blood flow of the four extremities ten minutes after the injection of the atropine. Five minutes after ion transfer was stopped, however, the treated extremity showed a significant average in-

crease in blood flow — namely, 42 per cent, with a range from +9 to +86 per cent. The untreated extremities showed insignificant average changes — namely, —8 per cent in the right upper extremity, —3 per cent in the left lower extremity and —1 per cent in the right lower extremity. The average heart rate decreased consistently from a control value of 68 to 64 beats per minute ten minutes after the injection of atropine, and to 62

TABLE 1. — *Changes in Heart Rate and in Blood Flow in the Treated Forearm and Hand Five Minutes After Ion Transfer Was Stopped (Group 1).*

Observations	Anode Area, Sq. In.	Solution at Anode	Ma.*	Increase in Flow, Per Cent	Heart Rate Beats Per Minute—Before Ion Transfer or Injection	Heart Rate Beats Per Minute—During Ion Transfer	Difference
12	19.7	Normal saline	30	14	71	70	—1
12	19.7	1:200 mecholyl	30	12	67	80	+13
12	About 57	1:200 mecholyl	20	31	69	74	+5
12	About 57	1:200 mecholyl preceded by atropine†	20	42	68	62	—6

* Strength of current in milliamperes.
† Preceded by 1/100 grain of atropine given subcutaneously fifteen minutes before ion transfer was begun.

TABLE 2. — *Comparison of Change in Heart Rate Resulting from Different Methods of Mecholyl Ion Transfer (Group 1).*

Anode Area, Sq. In.	Current, Ma.	Ma. Per Sq. In.	Increase in Heart Rate, Beats Per Min.*
19.7	30	1.5	+13
57	20	0.35	+5
Difference	....	.....	8
S. D.	....	.....	11.7
S. E.	....	.....	3.4
t	....	.....	2.4
P	....	.....	0.05-0.02

* Average of 12 observations.

during mecholyl ion transfer. The blood pressure averaged 111/68 before, and 108/68 during ion transfer.

The results of the observations in this group are summarized in tables 1 and 2. With a small anode there was no difference between the increase in flow produced by saline and by mecholyl ion transfer. The increases produced by both were small. The saline ion transfer did not result in any significant changes in pulse rate, whereas the mecholyl produced cardiac acceleration.

When the large anode was used, greater increases in blood flow were produced by mecholyl ion transfer, even though the current was smaller. The subcutaneous injection of atropine did not significantly influence the amount of increase in blood flow produced by mecholyl ion transfer. When the large anode was used for mecholyl ion transfer, much less cardiac acceleration was produced than with the small anode and greater current. Atropine slowed the cardiac rate even during mecholyl ion transfer.

The changes in the blood flow in the untreated extremities were variable and insignificant. All general symptoms (salivation, flushing, generalized

sweating) resulting from administration of mecholyl were prevented by the subcutaneous injection of atropine.

Group 2 (tables 3, 4 and 5 and fig. 1). — The blood flow in the lower extremities was not studied in this group. The total blood flow of the forearm and hand was studied after mecholyl ion transfer alone, the intravenous

TABLE 3. — *Effect of Mecholyl and Atropine on Heart Rate: Average of 11 Observations (Groups 2 and 3).*

	Mecholyl Alone*	Atropine Alone*	Mecholyl and Atropine†
Control rate	62	62	62
Highest rate during iontophoresis	69	....	....
Lowest rate after atropine	....	52‡	55
Difference	+7	—10	—7

* Mecholyl given by ion transfer, atropine injected intravenously.
† 1/200 grain (0.00032 Gm.) of atropine sulfate was injected intravenously five minutes before ion transfer was begun.
‡ Observations during a one hour period after injection of 1/200 grain of atropine sulfate.

TABLE 4. — *Effects of Mecholyl Ion Transfer or Intravenous Injection of Atropine or Both on the Blood Flow in Forearm and Hand of the Treated Extremity (Group 2).*

		Average Control Flow		Average Change in Blood Flow, Per Cent							
				—5 Min.*		—20 Min.*		—40 Min.*		—60 Min.*	
Observations	Procedure	Cc./Min.	Cc. per 100 Cc. Per Min.	Cc. Per Min.	Per Cent	Cc. Per Min.	Per Cent	Cc. Per Min.	Per Cent	Cc. Per Min.	Per Cent
6	Mecholyl ion transfer alone†	108	6.63	+62	+57	+42	+38	+33	+30	+37	+33
6	Atropine alone (1/200 grain)	116	7.23	—3	—4	—2	—2	+9	+8	+13	+10
6	Atropine (1/200 grain) 5 min. before mecholyl ion transfer†	120	7.45	+21	+19	+21	+17	+9	+6	+10	+7

* Time after the indicated procedure.
† Solution strength, 1:200; anode area, approximately 57 square inches, and current, 20 ma.

injection of atropine sulfate alone and the combination of atropine and mecholyl.

Mecholyl ion transfer produced significant average increases in the blood flow of the treated extremity. Five minutes after ion transfer was stopped, the increase in blood flow averaged 57 per cent, with a range from +23 to +83 per cent; at twenty minutes the flow averaged +38 per cent, with a range from +7 to +78; at forty minutes it averaged +30 per cent, and at sixty minutes, +33 per cent. The average changes in the blood flow of the untreated right upper extremity were insignificant — namely, —1 per cent five minutes, —10 per cent twenty minutes, —4 per cent forty minutes and —1 per cent sixty minutes after ion transfer was stopped. The pulse rate rose during ion transfer from an average control value of 60 to 67 beats per minute. After ion transfer was stopped, the heart rate decreased consistently below the control value and reached an average minimal rate of 53.

Atropine alone when injected intravenously produced no significant changes in the blood flow. The average changes in blood flow in the left upper extremity were as follows: —4 per cent five minutes, —2 per cent twenty minutes, +8 per cent forty minutes and +10 per cent sixty minutes

after injection. In the right upper extremity the average changes were as follows: no change five minutes, +2 per cent twenty minutes, +10 per cent forty minutes and —2 per cent sixty minutes after injection.

Atropine produced significant decreases in the average pulse rate from the control value of 60 to 51 beats per minute during the one hour period following the injection of atropine. The pulse rate of all 6 subjects decreased.

When atropine was injected intravenously five minutes before the beginning of mecholyl ion transfer, the increase of blood flow in the treated extremity was not as great as it was when mecholyl ion transfer was given without the injection of atropine. The average increases in the blood flow in the treated extremity were as follows: 19 per cent five minutes after ion transfer was stopped, with a range from +6 to +36 per cent; 17 per cent at twenty minutes, with a range of change from —16 to +48 per cent; 6 per cent at forty minutes, with a range from —27 to +50 per cent, and 7

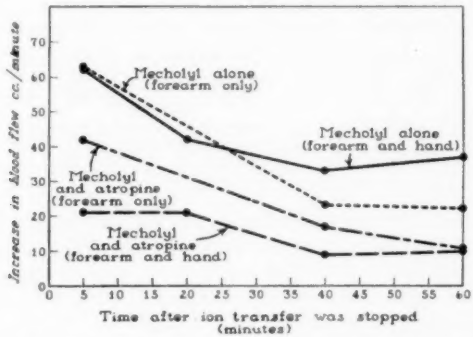

Fig. 1. — Comparison of the average increases in blood flow produced in the treated extremity by mecholyl ion transfer alone and by mecholyl ion transfer preceded by atropine given intravenously.

per cent at sixty minutes, with a range from —15 to +27 per cent.

The average changes in the blood flow of the untreated extremity were insignificant — namely, +2 per cent five minutes, no change twenty minutes, —3 per cent forty minutes and —2 per cent sixty minutes after ion transfer was stopped.

There was a significant decrease in the average pulse rate during the ion transfer from the control values of 62 to 53 beats per minute. After ion transfer was stopped, the heart rate gradually returned to the control level.

These data indicate that the intravenous injection of atropine before mecholyl ion transfer significantly reduced the magnitude of increase in blood flow which was produced by mecholyl. However, the administration of atropine alone resulted in no significant change in blood flow. The changes in heart rate were similar to those noted in group 1; mecholyl consistently produced acceleration and atropine slowing of the heart. The degree of slowing produced by atropine was the same when it was given alone or followed by mecholyl.

Group 3 (tables 3, 6 and 7 and fig. 1). — In this group the hand was excluded from the plethysmographic study by a pressure of 300 mm. of mercury at the wrist, and the blood flow in the forearm only was studied after mecholyl ion transfer, after the intravenous injection of atropine sulfate and after the combination of injection of atropine followed by mecholyl ion transfer.

Significant average increases in the blood flow of the treated forearm were produced by mecholyl ion transfer alone. Five minutes after ion transfer was stopped, the increase in blood flow averaged 195 per cent, with a range from +121 to +272; at forty minutes the average increase in flow was 70 per cent, with a range from +49 to +91, and at sixty minutes the average increase was 68 per cent, with a range from +2 to +111 per cent. In the untreated forearm, the average changes in blood flow were insignificant — namely, —9 per cent five minutes, +2 per cent forty minutes and +16 per cent sixty minutes after ion transfer was stopped.

The average pulse rate increased from the control value of 64 to the value during ion transfer of 71. After ion transfer was stopped, the heart rate gradually returned to the control level.

The injection of atropine alone resulted in only small and variable changes in blood flow. In the left forearm the average changes were as follows: +8 per cent five minutes, +16 per cent forty minutes and —5 per cent sixty minutes after injection. The average changes in the right forearm were the following: +16 per cent at five minutes, +14 per cent at forty minutes and —1 per cent at sixty minutes.

TABLE 5. — *Changes in Blood Flow in Cubic Centimeters per Minute in Forearm and Hand of the Treated Extremity Produced by Mecholyl Ion Transfer Alone and by Mecholyl Ion Transfer Preceded by Intravenous Injection of Atropine.*

	5 Min.* Change in Flow			20 Min.* Change in Flow			40 Min.* Change in Flow			60 Min.* Change in Flow		
Observation	Mecholyl	Mecholyl and Atropine†	Difference	Mecholyl	Mecholyl and Atropine†	Difference	Mecholyl	Mecholyl and Atropine†	Difference	Mecholyl	Mecholyl and Atropine†	Difference
1	+98	+45	+53	+92	+56	+36	+98	+63	+35	+25	+32	—7
2	+95	+8	+87	+69	+50	+19	+53	+38	+15	+66	+43	+23
3	+30	+8	+22	+30	—13	+43	+4	—23	+27	+9	—6	+15
4	+46	+12	+34	+33	+12	+21	+28	—15	+43	+24	—16	+40
5	+78	+29	+49	+18	+39	—21	+14	+20	—6	+52	+10	+42
6	+26	+25	+1	+8	—19	+27	+1	—32	+33	+43	—3	+46
Average	+62	+21	+41	+42	+21	+21	+33	+9	+24	+37	+10	+27
S. D.	....	....	29.4	....	....	22.4	....	....	17.6	....	....	20.4
S. E.	....	....	12.0	....	....	9.1	....	....	7.2	....	....	8.3
t	....	....	3.4	....	....	2.3	....	....	3.3	....	....	3.3
P	....	....	.02—	....	....	.1—	....	....	0.02	....	....	0.02
	....	....	.01	....	....	.05—	....	....		....	....	.....

* Time after stopping ion transfer.
† 1/200 grain (0.00032 Gm.) of atropine sulfate was injected intravenously five minutes before mecholyl ion transfer with a 1:200 solution was begun.

Atropine did produce significant slowing of the heart, as in the other groups, with a decrease in the average rate from the control value of 64 to 54 during the one hour period following the intravenous injection of atropine.

When 1/200 grain of atropine was injected intravenously five minutes before mecholyl ion transfer was begun, the blood flow still increased in the forearm to which the ion transfer was given, but the increase was not as great as when mecholyl ion transfer was administered without the injection of atropine. Five minutes after ion transfer was stopped, the increase in blood flow averaged 138 per cent, with a range from +37 to +228 per cent; at forty minutes the average increase in flow was 57 per cent, with a range from +10 to +178 per cent, and at sixty minutes the average increase was 39 per cent, with a range from +4 to +74 per cent.

The average changes in the blood flow of the untreated forearm were

insignificant — namely, —13 per cent at five minutes, +3 per cent at forty minutes and no change at sixty minutes.

Similarly in this group of observations atropine still produced significant slowing of the heart, despite the mecholyl ion transfer which produced cardiac acceleration when given alone. The average rate fell from the control value

TABLE 6. — *Effects of Mecholyl Ion Transfer or Intravenous Injection of Atropine or Both on the Blood Flow in the Treated Forearm (Group 3).*

		Average Control Flow		Average Change in Flow, Per Cent					
				5 Min.*		40 Min.*		60 Min.*	
Observations	Procedure	Cc. Per Min.	Cc. Per 100 Cc. Per Min.	Cc. Per Min.	Per Cent	Cc. Per Min.	Per Cent	Cc. Per Min.	Per Cent
5	Mecholyl ion transfer alone†	.34	2.95	+63	+195	+23	+70	+22	+68
5	Atropine alone (1/200 grain)	.38	3.24	+3	+8	+6	+16	—1	—5
5	Atropine (1/200 grain) 5 min. before mecholyl ion transfer†	.36	3.10	+42	+138	+17	+57	+11	+39

* Time after indicated procedure.
† Solution strength, 1:200; anode area approximately 57 square inches; current, 20 ma.

of 64 to 56 during ion transfer and remained practically the same during the one hour period after ion transfer was stopped.

As in group 2, the increase in blood flow produced by mecholyl ion transfer was less when atropine was injected before ion transfer than when mecholyl was given without atropine. However, the influence of atropine on the

TABLE 7. — *Increase in Blood Flow in Cubic Centimeters per Minute in Treated Forearm Produced by Mecholyl Ion Transfer Alone and by Mecholyl Preceded by Intravenous Injection of Atropine.*

	5 Min.*			40 Min.*			60 Min.*		
	Increase in Flow			Increase in Flow			Increase in Flow		
Observations	Mecholyl	Mecholyl and Atropine†	Difference	Mecholyl	Mecholyl and Atropine†	Difference	Mecholyl	Mecholyl and Atrophine†	Difference
1	+57	+39	+18	+23	+14	+9	+1	+6	—5
2	+52	+46	+6	+20	+15	+5	+18	+14	+4
3	+60	+19	+41	+24	+5	+19	+37	+2	+35
4	+69	+58	+11	+31	+48	—17	+41	+20	+21
5	+76	+48	+28	+17	+5	+12	+12	+14	—2
Average	+63	+42	+21	+23	+17	+6	+22	+11	+11
S. D.	....	....	14	....	....	13.6	....	....	16.9
S. E.	....	....	6.3	....	....	6.1	....	....	7.5
t	....	....	3.3	....	....	1.0	....	....	1.5
P	....	....	0.05–0.02	....	....	0.4–0.3	....	....	0.2

* Time after stopping the ion transfer.
† 1/200 grain (0.00032 Gm.) of atropine sulfate was injected intravenously five minutes before mecholyl ion transfer with a 1:200 solution was begun.

blood flow after ion transfer was not as marked in the study of the flow in the forearm alone as in the combined flow of the forearm and hand.

Comment

It is believed that atropine annuls the muscarine action of cholinergic drugs by preventing the drug from penetrating the effector cell. The ability of atropine to decrease or prevent action of mecholyl on any group of cells,

therefore, may be considered indicative of the presence of cholinergic fibers terminating at these cells. Thus, for example, the prevention by atropine of the sweating and salivation produced by mecholyl shows that the sweat and salivary glands are innervated by cholinergic fibers. In our study, atropine significantly reduced the magnitude of increase in blood flow produced in the extremity treated by mecholyl ion transfer and thus provided further evidence for the existence of cholinergic vasodilator fibers in the peripheral vessels.[18]

The antagonistic effect of atropine on the increase in blood flow produced by mechylol was greater in the study of the combined flow of the forearm and hand than in that of the forearm alone.

Smaller increases in blood flow were produced by mecholyl with the small anode than with the large one, even though the concentration of current was greater in the former. This suggests that the increase in blood flow depends not on the concentration of current but on the area covered by the anode. This may be explained by the relatively superficial action of mecholyl. The increase in pulse rate, however, was much greater with the small than with the large anode, indicating that the amount of mecholyl absorbed into the general circulation depends on the current.

Summary

The effects on the peripheral blood flow of atropine injected intravenously, of mecholyl ion transfer and of mecholyl ion transfer preceded by an injection of atropine were studied on 23 normal human subjects, on whom eighty-one observations were made. The blood flow in the extremities was determined by means of the venous occlusion plethysmograph with the compensating spirometer recorder, and the heart rate and blood pressure were determined by the usual clinical means.

Mecholyl ion transfer caused cardiac acceleration. The amount of acceleration produced by mecholyl was greater with the small anode and higher current than with the large anode and small current. Atropine consistently produced slowing of the heart whether injected alone or in combination with mecholyl ion transfer.

Mecholyl ion transfer produced significant increases in blood flow in the treated extremity. Greater increases in flow were produced with the large anode (57 square inches) than with the small one (19.7 square inches). The magnitude of increase in blood flow produced in the treated extremity by mecholyl ion transfer alone was much greater than when 1/200 grain (0.00032 Gm.) of atropine sulfate was injected intravenously five minutes before ion transfer. This inhibitory action of atropine on the increment in blood flow produced by mecholyl provides further evidence for the presence of cholinergic vasodilators in the extremities.

Discussion

Dr. Irvin F. Hummon, Jr. (Chicago): Dr. Gersten has so conclusively proved his point that atropine will result in a decrease in the effectiveness of mecholyl when given by ion transfer that his conclusions are definitely valid. The experimental work which he has done, I think, illustrates very well some of the general properties of ionic medication.

In the use of the two sizes of electrodes and current differences, there actually was quite a marked difference in the current density per unit area. With the small electrode and the high current density or high current value, he was using about four and a half times the current density per unit area that he was using with the large electrode.

When one is using drugs of the type of mecholyl or histamine, one finds that there are two actions, a local and a systemic action, and that with high current density one gets a much more marked systemic action than one does with low current

18. Bûlbring and Burn.[13] Halméjac and Haimovici.[14]

density. This is illustrated by the fact that with the high current densities he gets a more marked cardiac effect than he does with the low current densities.

Theoretically, the total dose applied by ionic medication should be proportional to the current and time, providing that only the ion you are interested in is being transported.

The dose per unit area depends on the total dose and the area of the electrode. The predominance of local or general effects depends upon the dose per unit area and the rate of application.

PHYSICAL MEDICINE IN AMPUTATIONS *

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The thought of losing a part of one's body is not a pleasant one. Nevertheless, there are instances when it is the wiser bargain to exchange a member or part thereof for an extension of the lease on life. In general, there are definite rules to help decide for or against an amputation:

1. In severe trauma the chief deciding factor is whether or not the larger vessels are intact. Fractures, skin and muscle defects can be dealt with. In doubtful cases, if there are other severe injuries, amputation may be favored.

2. In case of complications to severe trauma, one may be able to save a part temporarily but may have to sacrifice it later because of vascular thrombosis, gas gangrene or secondary hemorrhage.

Prolonged suppuration is an important factor. Amputation seldom saves life in the early stages of an acute infection, since the danger then is the result of a septicemia (a systemic infection) and not a toxemia. The patient may, however, fail to develop a defense against the infection and as a consequence may later run the risk of dying of toxemia; in these circumstances, amputation is a life-saving procedure.

4. In cases of malignant tumor often amputation is justified just to relieve pain. If the tumor is not too far advanced, it is a life-saving measure.

5. Recurrent disability resulting from flare-ups of a chronic osteomyelitis or ulcers often is justification for amputation.

6. Useless extremities, because of deformities as a result of severe accidents, disease or congenital anomalies, are often better amputated.

It is said that there were 19,000 amputations in military service during World War II but over 120,000 major amputations during this same period among civilians.

Text-books describe many types of amputations for various levels of the extremities, but few of these are being used at the present time, for reasons which will be brought out subsequently.

Amputations of the toes, or of the toes with their metatarsal heads, cause little handicap to a patient. He can still wear his shoe, which will require no more alteration than tucking in of a piece of cotton to fill up the front end

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of the shoe. However, when an amputation is done in the tarsometatarsal junction or within the tarsal region, the forefoot is so shortened that its dorsiflexor muscles have not enough leverage to counteract the pull of the gastrocnemius and the foot goes into equinus position. As a result, the patient walks on the scar, which becomes painful and ulcerated. The only amputation about the ankle that has stood the test of time is the Symes. This is an amputation through the lower end of the tibia. The classic procedure is to cut off the lower 1½ or 2 inches of the tibia and fuse the tuber of the calcaneus with its attached soft structure to it. A popular modification is the cutting of the articular surface off the lower end of the tibia, with the internal and external malleoli. Then the calcaneous is carefully shelled out of its bed, and this cap of soft tissue is placed over the lower end of the tibia. This makes a nice end-bearing stump, which can be used without a prosthesis The prosthesis for this type of amputation is rather thick through the ankle, and so is not liked by women. This amputation site when applicable is favored by the Canadians; the English condemn it.

When amputating in the tibia, a 5½ or 6 inch stump is desirable. If more is left, there is likely to be circulatory embarrassment later. When the patient sits down, the stump rises out of the bucket a variable amount. To keep the end of the limb in the bucket, a stump or 3½ or 4 inches is required. However, it is well to leave it a couple of inches longer, in case it becomes necessary later to reamputate. The only muscles used in a below the knee amputation are the quadriceps to extend the stump; gravity will flex it. So, if for any reason one encounters a stump of less than 3½ inches, the hamstrings might be severed; this will permit raising of the posterior rim of the prosthetic bucket and thus prevent the stump from leaving the prosthesis when the wearer is sitting.

In a thigh amputation a stump of 10 to 12 inches measured from the top of the trochanter is desirable. There must be at least 6 inches of femur for the fitting of an above the knee prosthesis. Of the four groups of muscles which control the femur, three — the flexors, abductors and extensors — are attached close to the upper end of the femur. The fourth, or abductor group, are inserted all the way down the shaft. Experience has shown that to retain sufficient abductor power to offset the abductors 9 inches is required. Every inch beyond this is an advantage up to 11 or 12 inches. Beyond this point circulatory disturbances are encountered. A stump of less than 6 inches will not stay in the bucket. Four inches of femur is ideal for a so-called tilting table prosthesis. Limb makers look with disfavor on disarticulations. It is a great advantage if a small piece of femur can be left around which to mold the bucket. It keeps the prosthesis from rotating on the stump.

With bolder efforts being put forth in reclaiming lives from the grips of malignant tumors, even higher amputations than disarticulations are being done. I refer to the so-called hindquarter, or ilioinnominati, amputation. For this amputation, there is no well working prosthesis (fig. 1).

In connection with amputations of fingers, every effort should be made to preserve them — even if only part of a finger or, particularly, the thumb. There is nothing to be gained by preserving the wrist. Pronation and supination cannot be transmitted into a prosthesis at the present time, as the radius of rotation of the wrist is constantly changing, and at present there is no prosthesis whose bucket varies with different positions of the stump. Forearm amputations are made at 7 inches, measuring from the tip of the olecranon. The stump must be at least 4 inches long for an amputee to

control a below elbow prosthesis. Eight inches of humerus is desirable, but 3 inches measured from tip of acromium will do for an above elbow prosthesis. One inch of humerus is preferable to a disarticulation, as it helps to anchor the prosthesis and also gives a more symmetric-appearing torso.

Physicians speak of guillotine amputations and closed amputations. The later procedure is the preferable. In this procedure the amputation is so designed that the wound is sewed up after the amputation. It is used in clean extremities, in extremities in which the injury is too recent to be infected, or in extremities in which the infection has healed. The wound is left open in the presence of infection or in bad risk cases in which a few more minutes of anesthetic or surgical stimulation would mean the difference between life and death.

A stump should lie flat on the bed; pillows to flex the hip or knee are

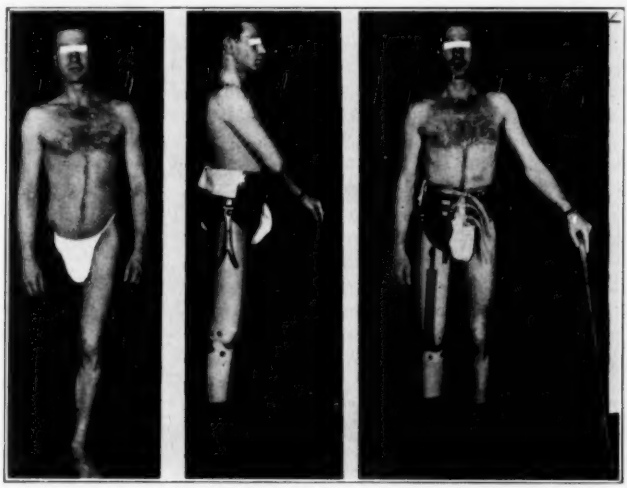

Fig. 1. — Ilioinnominate amputation and artificial limb.

not allowed. As soon as the stitches are out, the patient should be encouraged to move the amputation stump to prevent the muscles from becoming adherent to the skin. As soon as the wound is healed, one also begins to model and shrink the stump. It must be made to take the shape of a cone. There are two schools of thought on the method of procedure. One school feels that the stump can best be modeled and shrunk with a bandage. One large Ace bandage may be sufficient for a leg. Two are usually required for a thigh. Sew them end to end. There are various ways of wrapping a stump. It should be redone several times a day to derive full benefit. It must be applied in such a way that the end of the stump is the snuggest and that the snugness decreases as it progresses up the stump. The object of bandaging is to cause tissue atrophy and to produce a cone-shaped extremity. Errors to avoid are: (1) exerting a constricting effect, thereby causing edema distal to the constriction; (2) producing undue general tightness; (3) bandaging an unhealed stump too snugly.

The other school feels that the stump can best be modeled by use of an artificial limb or pylon. The pressure of a prosthesis bucket on a limb decreased the circulation, causing the muscles and subcutaneous tissue to

atrophy. As a result, the bucket then is too large and a new limb becomes necessary. This problem can be met by building a cheap pylon or replacing the bucket of a regular artificial limb. This first bucket or pylon must be built somewhat smaller than the stump and in the shape of a cone. Regardless of which procedure of shrinking is used, shrinkage continues for a year or more after the permanent limb is put on. Some of the limb discrepancy can be neutralized by fitting the bucket so that a very thin stump sock is worn at first, and, as shrinkage progresses, the regular stump socks are substituted. Conditioning of the stump can be begun sooner with the bandage technic, and it is more economical.

Hand in hand with the shrinking and toughening of the stump come the preprosthetic exercises. They are given to increase muscle strength of the amputated extremity and prevent contractures and also to maintain general muscle tone and posture. In a below the knee amputation, the knee tends to go into flexion. The aim is to develop the quadriceps. The hamstrings do not maintain their importance when an artificial limb is used. Gravity is depended upon for extending the knee of an artificial limb. The stump of a thigh amputation goes into flexion and abduction. In fact, when a person with a thigh amputation lies prone, he flexes and abducts the stump when he intends to extend it. Should this flexion-abduction tendency be allowed to persist, the limb maker would build the bucket at an incline and the patient would stand with a lateral pelvic tilt. Should there be a flexion contracture, the patient would have to stand in a position of lordosis. So it becomes obvious why stump muscles should be strengthened and coordinated and any contractures corrected should they exist.

There are various ways of giving exercises for the thigh. In general, exercises should be done in functional surroundings. One seldom uses a lower limb lying down. Why practice extension exercises lying down? If they are done standing, back and other thigh muscles will also work in coordination. One of the simplest hook-ups for extension exercises is to tie a pulley to a chair or wall at midthigh height. A rope is run through this pulley; the lower end is weighted and the other fastened to the thigh band. The stump is inserted through this band and the patient begins raising the weight by extending the stump. One must remember to motivate the stump from the hip joint and not from the back (fig. 2).

When the patient is given his prosthesis, three things should be stressed: balance; swinging the limb forward without abducting it, and extending the artificial knee at the end to the forward swing.

A normal person, when standing on one limb, maintains his balance with his foot muscles. A patient with an artificial limb has to rely on the muscles of his hip. These muscles have to learn this new function. The patient stands in front of the technician with hands on the technician's shoulders to steady himself. After a few attempts, he is able to take the sound limb off the ground, then to do so without holding to the technician and finally to do so while flexing the sound knee and hip to a right angle. Balance can best be obtained by keeping the limb close to the line of gravity, or the weight-bearing axis. Another way of saying it is to keep the heels just far enough apart to keep them from rubbing as they pass each other. Another point that contributes to proficiency is to keep the feet as close to the floor as possible without undue shuffling and scuffing. Some instructors have their patients learn by sliding the foot along the floor at first. To lift the foot considerably off the floor requires an unusual amount of pelvic lift, and that becomes tiresome if the patient walks much.

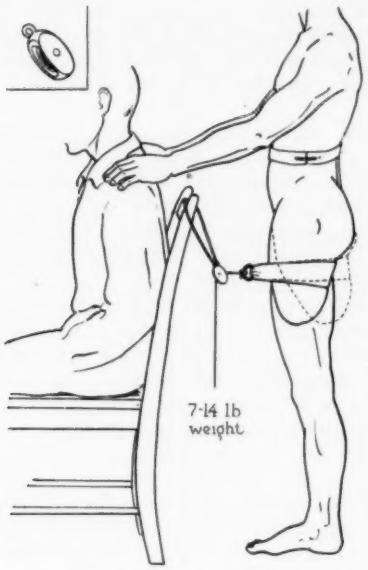

Fig. 2. — Setup for exercising a thigh stump in functional position.

Fig. 3. — The amputee should learn to keep an artificial limb close to the line of gravity. The limb should be lifted by bending the knee and not by elevating the pelvis.

Fig. 4. — The heel is set and pulled back as if the subject were making a mark on the floor.

Patients who abduct the limb in walking have not learned to use the hip joint and abductor muscles. If one uses the trunk to swing the limb forward, it first has to be abducted or circumducted to clear the floor. Walking should not be attempted until the patient is able to swing the leg forward without abducting it, for a circumduction gait once acquired is hard to eradicate.

A normal person has his knee slightly flexed at the end of the forward swing. He holds it with his quadriceps muscle. A limb wearer must learn to extend the artificial knee by the use of his hip extensors. At the completion of the forward swing, he is therefore taught to place the heel on the ground and to press backward with the stump muscles, an action similar to making a mark on the ground. To accomplish this locking in extension, so that the limb will not collapse when the body weight is taken, there is a tendency to take a longer step with this limb. This tendency is further accentuated if the knee joint goes into hyperextension. It has been calculated that for each 5 degrees of hyperextension the length of stride is increased one and three-fourths times. Hence the length of stride with this limb and the amount of extension of the knee joint must be checked; there should be just enough hyperextension for security and no more. The limb should be slightly shorter than the well leg (fig. 4).

Once the principles of gait have been learned, it takes practice to gain a certain momentum of swing to the limb to gain rhythm and stride. That should be the goal. One should not be satisfied with letting his patients just get around.

EFFICACY OF PERIPHERAL-ACTING DRUGS IN THE TREATMENT OF EXPERIMENTAL SPASTICITY *

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and

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Prolonged muscular shortening or spasticity occurring from causes such as nerve lesions or muscle injuries has long been the subject for therapeutic research. A state of continuous prolonged shortening is deleterious to skeletal muscle, as is evidenced by the atrophy and asthenia which occurs in the affected structures.[1] The types of muscular shortening occurring during poliomyelitis and tetanus have been extensively investigated and appear to possess many characteristics in common. The onset of shortening appears to be due to reflex hypertonus, inasmuch as it can be greatly diminished or abolished by either anesthesia or nerve section during the first few days of its existence. However, when this myotonic condition is allowed to persist, the muscle becomes set at the new shortened length and the maintenance of this condition thereafter becomes a peripheral entity, divorced from the neurogenic factor. After the onset of this myostatic state the affected muscles fail to relax upon either motor nerve section or under deep anesthesia.

Numerous reports have appeared of clinical investigations in which drug therapy was employed in an attempt to reduce the spasticity and thereby lessen the concomitant damage to muscle. These reports for the most part have been conflicting as well as inconclusive. Curare has been widely used as a therapeutic agent in the treatment of such clinical conditions as poliomyelitis, tetanus, muscle spasticity due to extrapyramidal tract lesions as well as an adjunct in anesthesia and electrical shock therapy. Ransohoff[2] has reported dramatic results with the use of Intocostrin as an aid to physical therapy in the treatment of muscle spasm in the acute stage of poliomyelitis. His claim for the beneficial effects of Intocostrin was not confirmed by Richards and co-workers.[3] Rosenberg and Fischer[4] did not obtain favorable results from the use of Intocostrin in the acute stages of poliomyelitis. Fox[5] found that while the patients indicated they had improved, objective tests proved otherwise. Kabat and Knapp[6] have reported that neostigmine decreased the muscle spasm (hypertonus and proprioceptive reflex hyperirritability) in poliomyelitic patients. Kabat[7] found neostigmine therapy efficacious in relieving muscular spasm and pain in clinical cases of spasticity (hemiplegia, cerebral palsy, poliomyelitis, arthritis and post-traumatic disability). This investigator found that administration of neostigmine caused an increase in the strength of voluntary movements in cases of chronic neuro-

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muscular dysfunction. Brainerd and co-workers[8] used neostigmine in treating poliomyelitic patients and concluded that it caused a temporary relaxation of muscular spasm. Inconsistent results with this drug were reported by Fox and Spankus.[9] Ranson and Dixon[10] have reported that the administration of ammonium chloride by gavage to animals which had received injections of tetanus toxins markedly diminished the subsequent tetanus and mortality. The rationale for ammonium chloride therapy is based upon its well known effect on the acid-base balance of the body fluids and the effect of hydrogen ion changes upon neuromuscular excitability and cholinesterase activity.

This report is concerned with a quantitative study of the effects of the peripheral-acting drugs, neostigmine, curare (Intocostrin and d-tubocurarine) and ammonium chloride upon experimentally produced spasticity in laboratory animals. In a previous report[1] an account was given of a method for producing a very satisfactory condition of prolonged shortening in the extensor muscle group of the adult albino rat. The value of this method lies in its reliability and ease of production and measurement characteristics which facilitate the use of animals in numbers sufficient to allow adequate controls and statistical analysis. The muscle shortening was produced by the local injection of a standardized dose of tetanus toxin. By properly gauging the dose of the tetanus toxin, it was possible to restrict the effect to the muscles of one limb, thus permitting the contralateral limb to serve as the normal control. It is also possible to produce varying degrees of spasticity in the muscles by grading the dosage of tetanus toxin. The resultant muscle shortening and rigidity, which appear to be initiated by reflex hypertonus, can be abolished by either deep anesthesia or motor nerve section during a period of several days after its onset. However, when this myotonic condition is allowed to persist the muscle becomes set at the new shortened length and does not relax upon either motor nerve section or deep anesthesia. During this time the muscle undergoes progressive atrophy and loss of strength.

Experimental Methods

The condition of shortening and rigidity was produced in the extensor muscle group of one hindlimb of adult albino rats (Spragus-Dawley strain) by the injection of a suitable dose of standardized tetanus toxin into the popliteal space. The dose of tetanus toxin was insufficient to affect the contralateral limb and hence allowed it to serve as a normal control. In each experiment the animals, previously matched as to age, sex and body weight, were given injections of aliquots of the same tetanus toxin preparation and divided into two groups. One group served as untreated controls, and the other group received the drug under investigation. The maximum sublethal dose for each drug had been determined in preliminary experiments. Observations of the following were made in both groups during the course of the experiment: the time of onset and degree of muscle shortening; the mobility and general condition of the ankle joint; the reaction of the animal to the substance administered. Fourteen days after the injection of the desired dose of tetanus toxin, measurements were made of the weight and strength of the experimental and contralateral control gastrocnemius muscles. The fourteen day period was considered optimal because shortly after this time the muscles begin to recover from the effects of the tetanus toxin. The methods which were employed for muscle stimulation and strength measurements have been described in detail elsewhere.[1] Muscle strength was considered to be the maximal isometric tension which developed in response to either direct or indirect stimulation. While the animals were under ether anesthesia,

8. Brainerd, H.; Katz, H. J.; Rowe, A. P., and Geiger, J. S.: The Clinical Manifestations of Poliomyelitis, J. A. M. A. **128**:718, 1945.
9. Fox, M. J., and Spankus, W. F.: The Value of Neostigmine in Acute Anterior Poliomyelitis, J. A. M. A. **128**:720, 1945.
10. Ranson, S. W., and Dixon, H. H.: Effect of Ammonium Chloride on Development of Rigidity in Experimental Local Tetanus, J. Pharmacol. & Exper. Therap. **38**:51, 1930.

the tendon of Achilles was cut and attached to a Blix torsion rod. A portion of the femur was then exposed and fixed in a rigid clamp. The intact muscle was directly stimulated through two needle electrodes which pierced it, one at the tendon, the other at the origin. Adjustable silver electrodes were placed in contact with the nerve for indirect stimulation. Short volleys of slightly supramaximal stimuli either from an inductorium or as condensor discharges were delivered to the muscle and nerve. The stimulus pattern and initial muscle tension adjustments were those which in preliminary experiments had been found optimal for maximum tetanus tension development. The extent of muscle shortening which took place during excitation was measured from optical records. At the conclusion of the strength measurements, the gastrocnemius muscles were carefully dissected out and the weights recorded.

D-tubocurarine was administered subcutaneously to 10 rats on the third day after the injection of one-half a "full" dose of tetanus toxin, a "full" dose being the maximal dose which will produce spasticity in the experimental limb within three days without eliciting any effect in the contralateral limb. The animals received injections four times daily at four to five hour intervals in amounts from 0.1 to 0.2 cc. of an aqueous solution containing 1 unit of d-tubocurarine per cubic centimeter. The exact dosage for each animal was adjusted according to its susceptibility to curarization. Intravenous injections of aqueous solutions and intramuscular injections of d-tubocurarine in oil were tried but found to elicit variable responses and were unsatisfactory routes of administration for the purposes of our experiments. After six days of curare therapy (nine days after the injection of tetanus toxin) measurements were made of the weight and strength of the spastic and contralateral nonspastic gastrocnemius muscles in 5 treated and 5 control animals. The remaining 5 experimental and 5 control animals were tested at the end of the fourteen day period. The effect of Intocostrin was studied in a group of animals which had received a unilateral injection of two-thirds of a "full" dose of tetanus toxin. The subcutaneous injections were made three times daily and commenced one day after the toxin injections. The animals received at each treatment from 0.1 to 0.2 cc. of an aqueous solution containing 1 unit of Intocostrin per cubic centimeter. Fourteen days after the injection of tetanus toxin, measurements were made of the weight and strength of spastic and control gastrocnemius muscles in 7 experimental and 10 control animals.

Neostigmine therapy was begun on the same day that the animals were injected with a "full" dose of tetanus toxin. The animals received daily intraperitoneal injections of 0.02 mg. together with an average additional amount of 0.85 mg. in the drinking water. Measurements of muscle weight and strength were made at fourteen days after tetanus toxin injection in 14 treated and 14 control animals.

Ammonium chloride was given by gavage three times daily beginning on the day on which the "full" dose of tetanus toxin was injected. The dosage, 3 cc. of a 5 per cent solution of ammonium chloride was administered under light ether anesthesia to lessen the possibility of laryngeal spasm elicited by irritation of the tubing. The 4 experimental and 8 control animals were tested on the fourteenth day after injection of tetanus toxin.

Results

The average values for the effects of curare, neostigmine and ammonium chloride therapy upon the weight and strength of spastic gastrocnemius muscles are presented in charts 1 to 4. The values for muscle weight, total tension and tension per gram weight elicited through direct and indirect stimulation of the spastic gastrocnemius muscles were expressed as per cent of the values obtained from comparable measurements of the nonspastic contralateral limb. The latter

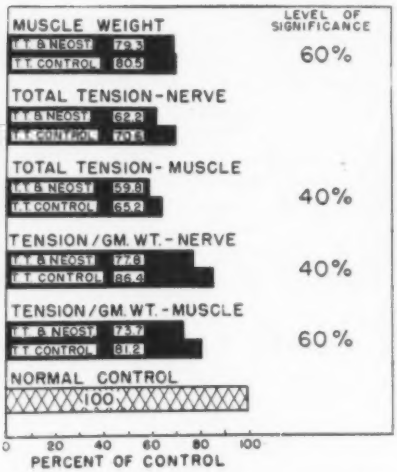

Chart 1. — The effect of neostigmine upon weight and strength of spastic gastrocnemius muscles. Values on spastic muscles are expressed as per cent of those on the normal contralateral control.

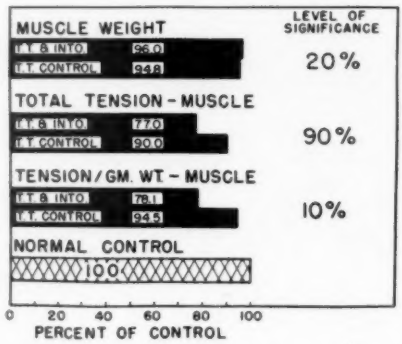

Chart 2. — The effect of curare (Intocostrin) upon weight and strength of spastic gastrocnemius muscles. Values on spastic muscles are expressed as per cent of those on the normal control.

were taken as 100 per cent. These percentages for the treated group were then compared with those for the untreated group. The data were analyzed statistically, using the small sample theory "t" test. The 2 per cent level of confidence was regarded as the critical level of confidence for concluding that a true difference existed between the treated and untreated groups. The 5 per cent level was considered not highly significant but strongly indicative of a difference.

The data show that the repeated administration of large doses of curare, neostigmine or ammonium chloride failed to protect the muscles from the effects of prolonged shortening. No significant difference was found for the weight and strength of spastic gastrocnemius muscles in the treated and untreated groups.

The dose of drug employed was near the maximal amount which could be tolerated by the animal. Temporary relaxation of the control and spastic limbs of the curare-treated animals was observed approximately three minutes after administration. The spastic limb appeared to return to the original hypertonic state within a period of twenty to thirty minutes. The relaxation caused by curare and neostigmine was of a generalized nature and no selective "lissive" action on the spastic limb was observed. The severity of the curare reaction was tested by the ability of the animal to right itself when placed on its back. The inability to turn over was often followed by bulging eyes, irregular respiration and asphyxial spasm which necessitated the use of artificial respiration. The cumulative effect of repeated curarization was noted after the second or third daily injection which necessitated a reduction of dose in subsequent injections. Ammonium chloride therapy failed to exert any effect upon the onset and severity of the reflex hypertonus produced by a localized injection of tetanus toxin. There was no significant difference between the treated and untreated control groups in the weight and strength of spastic muscles. Although these results do not confirm those of Ranson and Dixon,[10] they do not preclude the possibility that ammonium chloride may not exert a protective action against the spread of a generalized tetanus.

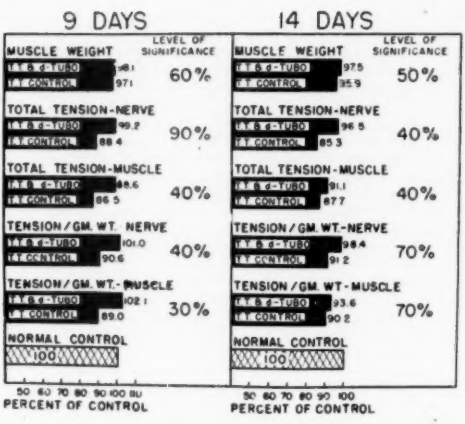

Chart 3. — The effect of d-tubocurarine upon weight and strength of spastic gastrocnemius muscles. Values on spastic muscles are expressed as per cent of those on the normal contralateral control.

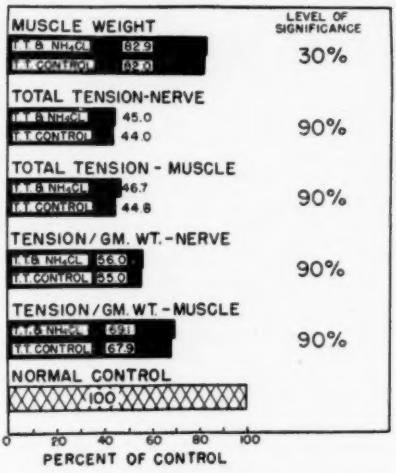

Chart 4. — The effect of ammonium chloride upon weight and strength of spastic gastrocnemius muscles. Values on spastic muscles are expressed as per cent of those on the normal contralateral control.

Comment

The maximal amount of relaxation resulting from the repeated administration of large doses of curare and neostigmine was insufficient to allow spastic muscles to regain their normal resting length. The extent and duration of the relaxation were insufficient to protect the muscles from the injurious effects of prolonged shortening. The absence of any selective "lissive" action of these drugs on spastic muscles made it necessary to employ near paralytic doses to bring about an appreciable degree of relaxation. These studies point to the futility of employing this drug alone for the prevention of the damage to skeletal muscle which results from a state of prolonged shortening but do not point to any contraindication for their use in the facilitation of mobility and coordination in this type of neuromuscular disorder.

Summary

Studies were made on the efficacy of curare (d-tubocurarine and Intocostrin), neostigmine and ammonium chloride in lessening the muscle damage which occurs in a condition of prolonged muscle shortening produced experimentally in the gastrocnemius muscle group of albino rats by the injection of tetanus toxin. It was concluded from the measurements of muscle weight and strength of the spastic muscles, both treated and untreated controls, that of the drugs investigated, curare and neostigmine produced some degree of relaxation but were not alone able to bring about sufficient elongation of the shortened muscle to prevent or lessen the atrophy and loss of strength which occur in skeletal muscle during a state of prolonged shortening. Ammonium chloride did not alter the progress of the spasticity or the conditions of atrophy and strength loss.

Discussion

Dr. Frederic B. House (Ann Arbor, Mich.): We are again indebted to Professor Hines and his group for much needed objective data on one of our foremost clinical problems. I should like to congratulate Miss Hajek on her careful work and understandable presentation.

The authors have stated that by spasticity they mean a state of prolonged muscle shortening. This condition of muscle spasm would seem to simulate that found in acute anterior poliomyelitis very well. As has been shown it is associated with loss of strength and weight.

However, spasticity as we know it in cerebral palsy is probably a different condition. In these cases spasticity is identified by the finding of the stretch reflex and the muscle does not show evidence of wasting. In fact, the reverse may be true. Most of us have readily explained this type of spasticity as due to a loss of an inhibition effect normally supplied by the higher centers. Some more critical observers have not accepted this explanation so quickly, and the true nature of the mechanism causing this type of spasticity must be said to be unknown.

Together, these two types of muscle spasm make up one of the most difficult problems in physical medicine. We hope that future work, such as that that we have just heard described, will help us find better technics for handling this problem.

Dr. Edmund F. C. Wadge (London, England): We know, of course, of the work that has been done on muscles deprived of their normal nerve supplies and the researches made into peripheral nerve injuries, but I think that this present work on the effects of therapeutic measures in experimental muscular spasticity is a most valuable contribution to a branch of our subject which has not as yet been sufficiently investigated.

First, I should like to point out that the definition of spasticity that obtained in this series is prolonged muscle shortening. I think that is most important, and I realized that fact when I came to consider this paper, because I found it so difficult to give myself an adequate definition of spasticity. In effect, the problem as presented is one of muscle shortening, but I think that this does not necessarily compare with the condition of muscle spasticity as found in central nervous system lesions in men.

When further experiments are done on this subject in the future, it might well be of interest if electromyography were employed. This aspect was not touched on in the present series. Also, I should like to ask whether biopsies were performed to obtain records of any changes in the muscle, such as muscle — fibrous tissue relationship or changes in the chemical constituents.

With regard to the conclusions arrived at, I think we can say that the findings obtained by this series of experiments are in agreement with our practical clinical experience in men, as far as the two can be correlated. I particularly agree that gentle stretchings — and they must be gentle — are an effective therapeutic measure, probably the most effective, and in my very limited experience, stretching under curare relaxation is not the best treatment. I personally employ only slow stretching within the pain-free range, thus avoiding the injurious overstretching that has been referred to.

It is known and accepted that electrical stimulation of denervated muscle is best carried out in the stretched, but not overstretched, position and that the tension factor is of great importance. The findings in the present series of spastic muscles are in agreement with this. Electrical stimulation might be expected to retard atrophy in spastic muscles and not otherwise improve their functional condition, since this agrees with the results obtained in peripheral nerve injuries. However, electrical stimulation is not very usually applied in the extremity of spastic conditions in man, at any rate in England. However, it should be borne in mind that the condition obtaining for the purpose of these researches, that of spasticity as it has been defined in animals, is not necessarily strictly comparable with the spastic condition that we find and have to treat in man. In the series reported here it was obtained by means of a foreign agent, tetanus toxin. In man the condition is usually associated with lesions of the central nervous system as a whole, usually of a chronic nature rather than of, say, fourteen days' duration, and it may be of a mixed type, an irritant factor being superimposed upon or combined with motor impairment, and motor incoordination will be pronounced.

It is fortunate that in man we are able to employ, in addition to drugs and stretching, other physical therapy measures which cannot be made use of in spastic conditions in animals. These methods include exercises to promote and improve coordination and the group of reeducative exercises in general, and, in addition, the patient can be taught and helped to relax.

I think that the findings that have been reached are of great value and interest, and I hope that further investigations along these lines will be continued by such able workers.

Miss Hajek (closing): Biopsies were not done, but studies of the histologic changes occurring in treated and untreated spastic and normal muscles were carried out. Little deviation from a normal muscle picture was seen. The curare-stretched group presented the most pathologic change with the appearance of fibritic areas.

Analyses of the creatine and water content of the muscles were also made. The normal stretched muscles showed an increase in the water and decrease in the creatine content compared with normal controls. The spastic muscles stretched under curare suffered a greater loss of creatine than did the muscles stretched without curare. The increase in water content was approximately equal in the two groups.

Electrical stimulation of the spastic muscles caused a decrease in the creatine content and increase in the water content. Stimulation in the stretched position elicited a greater decrease in the creatine and a greater increase in the water content than stimulation in the unstretched position.

COLONIC IRRIGATION

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CHICAGO

Does colonic irrigation have a place in a department of physical medicine of a large general hospital? Research in this field has been meager, and this fact accounts for the controversial nature of the subject. Moreover, the indiscriminate use of colonic irrigations by inexperienced or irresponsible operators, without regard to its limited indications and numerous contraindications, has added ammunition to the controversy, and many medical men in the past have warned of its potential dangers, such as hemorrhage due to trauma, perforation of bowel or diverticulum, irritation, habit formation, torn rectal valves due to trauma, abdominal distention and a sense of weakness.

However, after fifteen years of experience, I believe that this question can be answered in the affirmative. Patients referred to our department of physical medicine for irrigations have steadily increased in numbers, because the results obtained have been satisfactory; and I know of no case in which trauma or other complications have been caused by our irrigation procedures.

Before going further, let us define and describe what is meant by the term colonic irrigation and differentiate it from the enema.

In 1933, the Council on Physical Therapy (now Physical Medicine and Rehabilitation) of the American Medical Association published an article by Dr. Walter Bastedo, who wrote: "Between enemas and irrigations there would seem to be no sharp dividing line, yet they are distinct in their purpose. In medicine, the term irrigation conveys the idea of washing; therefore, while the ordinary enema is given with the purpose of inducing defecation, the irrigation is administered, not to induce defecation, but to wash out material situated above the defecation area and to lavage the wall of the bowels as high as the water can be made to reach. To accomplish its purpose irrigation requires (1) that the fecal mass in the lower colon shall have been expelled and (2) that the liquid shall be passed into the colon so gently that it does not arouse the defecation reflexes. Otherwise, it is not a properly given irrigation."[1]

Indications and Contraindications

Before a colonic irrigation is given, it is understood that the physiatrist understands what is meant by a colonic irrigation and knows the indications and contraindications for such procedures. He should be familiar with the history and diagnosis of the case and the purpose of the irrigation. The technic used should be carefully prescribed after an examination; the nurse or technician giving the irrigation should be well trained, and the apparatus used should, in my opinion, be of the pressure and vacuum gauge variety.

In what conditions are colonic irrigations indicated? My colleagues and I use them for cleansing, for assisting in diagnosis and for corrective procedures.

1. For cleansing we remove fecal impactions and wash the colon before a primary operation for cancer or other tumor masses in the rectum or intestinal tract; we cleanse and wash the intestinal loop prior to closure of an ileostomy, colostomy or sigmoidostomy, and we cleanse the intestinal tract of a barium enema.

2. Under the diagnostic phase we irrigate in order to enable the referring

1. Bastedo, W. A.: Colon Irrigations—Their Administration, Their Application and Dangers, J. A. M. A. 98:734 (Feb. 27) 1932.

physician to make a better rectal examination, and to enable the roentgenologist to get clearer pictures of the bladder and colon. Fecal specimens may be obtained for laboratory study at any stage of the irrigation.

3. Corrective therapy in atonic or hypertonic colons is not a cleansing treatment. Its objective is to produce a state of tonicity in the musculature of the large intestine whereby the patient will defecate normally.

Contraindications for colonic irrigations are: (1) loose sphincter, (2) painful hemorrhoids or fistula, (3) debilitated patients, (4) numerous polypi, (5) tuberculosis, (6) rectal infections, (7) painful skin lesions around the anal opening, (8) syphilis, (9) massive carcinoma or other malignant tumors making it impossible to insert a rectal tube and (10) severe diverticulitis.

Methods of Irrigation

The methods of colonic irrigation are the one and the two tube technics. However, the one we have used since 1933 is a pressure and vacuum gauge apparatus with a single metal piece which is inserted into the rectum. This apparatus has a reversible pressure inflow and outflow, producing first a positive pressure with inflow and then, by reversing the levers, a negative pressure on the outflow. A mercury manometer measures accurately both the inflow and the outflow. Such an apparatus can be controlled accurately; first, with the amount of fluid introduced and the amount of fluid expelled. The mercury gauge indicates the pressure, which is important and valuable in keeping the danger of pressure to a minimum. Thus by watching the gauge one can control the treatment throughout, and by so doing potential dangers will be minimized. The apparatus has a metal tube which is easily inserted into the rectum and through which the fluid passes in and out of the rectum. These metal tubes are made in different sizes to fit most all patients. Therefore, because of the safety and ease with which a colonic irrigation can be given, we use the pressure and vacuum gauge apparatus.

Referral Information

Knowing the potential dangers which exist when giving a colonic irrigation, it is well to secure pertinent data of the patient's illness and general condition. When a patient is referred for colonic irrigation, the physiatrist should: (1) secure a diagnosis and a history of the case from the referring physician; (2) secure any unusual facts about the case—what to watch for; (3) note the purpose of the irrigation, and (4) if a tentative contraindication is apparent, explain the situation to the referring physician.

Preirrigation Instructions

The directions to the patients should be definite. Outpatients should take 1 or 2 tablespoons of mineral oil (or other substitute cathartic) the night before the irrigation. The patient should void or have an enema before the irrigation. For inpatients these orders are carried out by the nurse on the floor.

Procedure

Place the patient on the table in a left side lying position with the knees flexed. Use a rubber glove or finger cot well lubricated and make a careful examination to see whether fecal material is present, or whether other hard masses are fecal. This examination may reveal certain contraindications, such as a loose sphincter, painful hemorrhoids, etc. If no contraindications are found, insert a well lubricated metal tube of proper size. This should be done slowly and with great care. Direct the tube through upward and along the anterior surface of the sacrum. If small hemorrhoids are present, the pain and spasm from one careless insertion may preclude the subsequent use of the tube for weeks.

With the patient lying on the left side, give 3 quarts of water at a temperature of 104 F.; then place him on his back for the greater part of the irrigation and on the left side again for the last 3 quarts of water. For the first irrigation it is well not to give more than 2 or 3 gallons of water and not to keep the patient on the table longer than one-half to three-quarters of an hour.

The controls on the apparatus are regulated, and the water is allowed to run in slowly. The manometer should be watched closely, and when the positive pressure begins to rise, the controls which produce a vacuum or negative pressure are regulated. Thus the positive pressure is released and fluid from the irrigation passes through the outflow. Observe the return flow through the glass tubing and the amount of gas present, color of feces, whether there is any mucus present, and any odors given off. Record on colonic form. This technic is repeated constantly until the contents of the irrigation viewed through the glass tube are clear, or until 2 or 3 gallons of tap water is used. Additional irrigation may be given if the patient is strong enough to continue the treatment. If not, further irrigation may be necessary at a later time until the contents of the bowel are clear.

A moderate circular friction and stroking over the abdomen for ten minutes before the irrigation is a good procedure.

If the patient is distressed during the treatment, the region should be checked and the pressure shown on the manometer recorded.

At the conclusion of the treatment, the metal tube should be removed slowly and carefully, and the patient should be permitted to evacuate in toilet. The quantity and quality of the evacuation should be recorded.

When irrigating a patient with a fecal impaction, the manometer readings again should be carefully observed. The pressure will fall as the fluid gets around the impaction, showing that the impaction is beginning to loosen. However, stubborn impactions may take several irrigations, but with patience results can be usually obtained.

Irrigations Before Closure Operations

Irrigation of patients with ileostomies, colostomies or sigmoidostomies is done just before the closure operations. The objective of this treatment is to cleanse and wash the intestinal loop prior to closure.

A straight colonic irrigation is given rectally for about ten to fifteen minutes.

With the patient in supine position, a soft-nosed French catheter, the size dependent on the size of the abdominal opening, and well lubricated, is inserted into the upper opening from which fecal matter has been observed. This insertion is done with great care. It is never forced. It is well to flush the tube before inserting, and it should be inserted not more than 3 or 4 inches. This catheter is then connected with the inflow, and the metal rectal tube is connected with the outflow. A rubber bulb is connected to the tube which was the inflow tube.

When ready to irrigate, run the tap water in slowly, watching the positive pressure. When the manometer rises or the patient feels any discomfort, disconnect the catheter and permit it to siphon off. It is well to put a sterile gauze pad around the abdominal opening. The catheter is connected to the inflow and the procedure is repeated until the tap water has reached the rectal opening where there is a continuous flow. The rubber may be used in the production of a continuous flow. Continue the flow from the abdominal opening to the rectum until contents are clear. A reverse flow may be used to get better results, but it is as a rule not necessary.

Corrective Treatment

The same procedures are used as with a straight colonic irrigation. With this procedure the manometer readings are watched very carefully. If the pressure increases, it indicates bowel tonus—i.e., there is an impulse to defecate in

response to the hydraulic massage. If, however, the pressure decreases, it may mean that a temporary spasm has relaxed and allowed the solution to proceed toward the cecum or that an impaction has loosened sufficiently to allow the solution to pass around it. When the bowel becomes tonic, a rise of pressure will be registered on the manometer when the point has been reached to allow voluntary expulsion.

Summary

Fifteen years of experience has taught us that there is a place for colonic irrigation in a large general hospital, but the indications for its use are definitely limited and its contraindications are numerous.

Before giving an irrigation, the physiatrist must understand the indications, the contraindications, the technics involved and the purpose of the irrigation. He should be familiar with the diagnosis and history of the case, and he should make an examination to detect any possible contraindication. The technician giving the irrigation should be well experienced in correct irrigation procedures, and the apparatus should be of the pressure and vacuum gauge variety.

POSSIBILITIES OF HYDROTHERAPY IN A PSYCHIATRIC HOSPITAL *

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and

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In the present paper we propose to consider, in as practical a manner as possible, various aspects of hydrotherapy, particularly with regard to its possibilities in treatment of psychiatric patients. We shall discuss, first, the different forms of stimulative and sedative hydrotherapy; second, a program of therapeutic swimming which has proved to be a valuable aid in the general treatment of psychotic patients in a number of hospitals, and, finally, an evaluation of the results of such a program as carried out in the United States Veterans Administration at St. Cloud, Minn.

At the turn of the century, Winternitz, a Viennese physician, stressed the importance of understanding the basic physiologic effects of the different forms of hydrotherapy so that they might be prescribed rationally. This man exerted great influence on two American physicians who studied under him, Simon Baruch and John Harvey Kellogg, both of whom wrote standard textbooks on hydrotherapy. In these books descriptions were included of many of the forms of stimulative and sedative hydrotherapy in use today. These three men did much to abolish the stigma of cultism from hydrotherapy.

* This paper is based upon observations made at the Veterans Administration Hospital, St. Cloud, Minn., where Dr. Nelson formerly was acting chief of the Physical Medicine Rehabilitation Service. Dr. Erickson is consultant in physical medicine, Rehabilitation Service, Veterans Administration, Branch 8.

Traditional Types of Hydrotherapy in a Psychiatric Hospital

Any department of physical medicine, whether it be in a general or in a neuropsychiatric hospital, should possess the following equipment for hydrotherapy: Sitz baths, contrast baths and arm and leg whirlpool tanks. In the latter type of hospital, facilities for the administration of both stimulative and sedative hydrotherapy should also be included.

Stimulative Hydrotherapy. — Any procedure which will contribute to the adjustment of newly admitted patients in a psychiatric hospital is valuable. Such patients often are bewildered and shocked at finding themselves in a mental institution. Moreover, commonly they are depressed, are preoccupied with their own problems and delusions and are underactive. For such patients, stimulative hydrotherapy in the form of the needle shower and the Scotch douche often is prescribed, with other forms of physical therapy, such as ultraviolet radiation and massage. Generally, a feeling of warmth, relaxation and increased vitality is experienced after this therapy has been employed. In addition, it tends to make the patients more amenable to hospital routine and more willing to cooperate in the diagnostic and therapeutic procedures required, such as psychiatric interviews, psychologic tests and psychotherapy, as well as in recreational and athletic activities that are carried out during this critical period.

The physiologic basis of the effect of the needle shower and Scotch douche may be explained as follows: As hot and cold streams of water impinge on the skin, sensations of touch, heat and cold are conveyed to the central nervous system. This stimulation causes reflex peripheral vasodilation, and an increase of muscle tone results. Subjectively, these effects are interpreted in the form of sensations of warmth and well-being.

Sedative Hydrotherapy. — Stimulative hydrotherapy is valuable in a neuropsychiatric hospital, but sedative hydrotherapy is well-nigh indispensable. Such therapy often succeeds in calming acutely disturbed patients after repeated doses of paraldehyde or barbiturates have failed to do so. The traditional forms of sedative hydrotherapy long employed in mental hospitals in the United States are the wet pack and the continuous tub bath. Another important type of sedative hydrotherapy is therapeutic swimming, which deservedly has been accorded wider recognition and use during the past two years. This form of therapy will be considered later in this paper.

The technics of the traditional types of sedative hydrotherapy can be summarized as follows:

Wet Pack: The patient is placed on a hard bed. Wet sheets wrung out of water at about 65 F. are wrapped about him in such a way as to prevent movement of arms and legs.[6] After this, two wool blankets are similarly applied. The room is darkened and kept as quiet as possible. Soft music may be played, however, because it seems to exert a quieting effect. A cold cloth is placed on the patient's forehead, and he is given fluids from time to time. His pulse and color should be checked frequently during the treatment, at least every half hour. The average period of treatment is from two to two and a half hours.

Continuous Tub Bath: The patient is placed in a large bath tub, usually upon a canvas "hammock." The inflowing water is regulated to circulate at a temperature of 93 to 96 F. The patient is covered with a loose sheet; if he is extremely hyperactive, a canvas cover may be placed over part of the tub to prevent him from climbing out. The temperature of the water shown on the thermostat must be checked by frequent readings with a thermometer in the tub.

The general care and period of treatment are similar for these two forms of hydrotherapy. Ordinarily, the treatments are carried out in the same room.

In 1934 a valuable study was made of the reactions of psychotic patients

to these types of sedative hydrotherapy. The investigators pointed out that the value of the treatment cannot be judged accurately on the basis of the subjective attitude of the patients. Often, a definite sedative action can be demonstrated objectively, even when patients assert violently their dislike of the treatment. It was concluded that, in the majority of cases studied, wet packs and continuous tub baths had definite and approximately equal sedative effects, regardless of the psychiatric condition of the patient. It was noted, however, that sometimes "increased restraint is met by rebellion." With these patients, such therapy actually could be harmful. Experience at the Veterans Administration Hospital at St. Cloud, Minn., tends to support this last observation, particularly with regard to wet packs, which at times seem to have an effect almost opposite to sedation.

In another study it was said that "In our experience continuous packs and neutral baths have been most effective as a means of supplying what the patient regards as punishment." These forms of therapy, at the time of this report, had not been used for this purpose at the hospital at St. Cloud. Moreover, it is believed to be most important to eliminate, as much as possible, any implication of punishment from the administration of wet packs and tub baths. The personnel who administer these treatments are instructed to be friendly and gentle and to avoid a teasing or threatening attitude in dealing with the patients.

In a recent paper it was implied that continuous tub baths can be given to psychiatric patients for days or weeks without harm. With this point of view we do not wholly agree. Although it is true that patients do definitely prefer tub baths to wet packs, both types of treatment encourage regression. In the ward "day room," various recreational activities can be scheduled which will help the patient to readjust socially. In the pack room, however, no attempt can be made by means of group activities to draw the patients out of their private worlds of fantasy and delusion. In addition, there is often a reversal of habits of sleep, so that patients sleep in the pack room during the day and remain awake at night, disturbing the entire ward. Hence, there are undesirable effects that must be considered in the prescribing of either wet packs or continuous tub baths over a prolonged period.

The physiologic effect of packs and continuous baths can be summarized as follows: When wet packs are used, there is an initial period of peripheral vasoconstriction, caused by the shock of the cold sheets. This is followed shortly by reflex vasodilation. Because the blankets prevent the escape of body heat, the patient soon lies in a warm, neutral environment very similar to that provided by the continuous tub bath, in which the water is maintained nearly at the temperature of the skin. The patient may perspire a great deal. In both forms of therapy, cutaneous stimulation is reduced to a minimum. With packs, there is a further reduction in the sensations that arise from voluntary muscular activity.

The importance of sedative hydrotherapy in the psychiatric hospital lies in the fact that it permits active therapy to be substituted for nontherapeutic restraint. Sedative hydrotherapy, however, also can be of great value outside the hospital in the treatment of the psychiatric patient, a fact which has not been generally realized. As an adjunct to psychotherapy, continuous baths can be of help to the psychiatrist by providing all-important relaxation for the very tense neurotic patients or patients on the borderline of a psychosis. The sedative action of wet packs probably should be given a trial in certain cases of insomnia. Patients who have multiple symptoms that do not have an organic basis might well derive benefit from such treatment,

because some of their symptoms no doubt are related to general tension and fatigue. It is likely that the potentialities of sedative hydrotherapy in this field have scarcely been explored.

A Program of Swimming as an Aid to Treatment

Until 1947, when swimming programs were initiated at the United States Veterans hospitals at Coatesville, Pa., and at Downey, Ill., it was not realized that swimming could be specifically utilized for the sedation of acutely hyperactive and assaultive patients. Practically no references to it have appeared in medical journals or textbooks of physical medicine.

For many years before the swimming program was instituted at the hospital at St. Cloud, the pack room, with its capacity of five tubs and ten pack tables, had proved satisfactory for the needs of the hospital. In the fall of 1946, however, several members of the medical staff said they believed that these facilities no longer were adequate, since on several occasions when sedative hydrotherapy was required for acutely disturbed patients the pack room was already filled. In view of the steadily increasing number of patients in the hospital, they believed that this was likely to become an even more critical problem. Therefore, on their recommendation, permission was requested to construct an additional pack room.

At the 1947 Annual Session of the American Congress of Physical Medicine, Lawrence said that the need for a pack room in the United States Veterans Hospital at Downey, Ill., had been almost eliminated after a swimming program had been initiated for hyperactive patients. Although approval had been given and funds allotted for the construction of the additional pack room at St. Cloud, work had not yet been begun. Therefore, a similar program of therapeutic swimming seemed to offer a satisfactory solution to the problem at this hospital at considerable savings. Accordingly, on Sept. 15, 1947, 9 of the most assaultive patients entered the swimming pool under the supervision of 4 specially trained attendants.

After a week's trial, it was apparent to the staff that therapeutic swimming was eminently satisfactory, and arrangements were made to continue it for an indefinite period. Because this program more than doubled the number of patients who could receive sedative hydrotherapy, the additional pack room was no longer needed. The estimated cost of construction of this room was $10,000.

As the program continued, fewer patients were brought to the pool under restraint. Nurses on the wards commented that the patients were much less disturbed than they formerly had been and that less sedation with drugs was required. This was understandable, for the patients, of course, had no chance to sleep during the day in the swimming pool. At night, then, they were tired and ready for sleep. The ward physician said that those patients who had been extremely irritable became much less so in the pool and that they "entered into the general spirit of camaraderie." Several patients manifested unexpected psychiatric improvement after a number of sessions in the pool and no longer required any restraint. A number were transferred to other wards, where a wider variety of recreational and athletic activities could be offered. Many of these patients had received other forms of sedative hydrotherapy over an extended time, with no more than temporary benefit. Because of the improvement in the attitude of the patients, one attendant from the ward for the most assaultive patients was relieved for other work.

Therapeutic swimming, like all forms of physical therapy, should be individually prescribed by the ward physician. It must be recognized that

this is not an easy thing to do in a large, usually understaffed, neuropsychiatric hospital. Although the physician will have to reply on the veracity and judgment of the nurses in recommending patients to be considered for sedative hydrotherapy, he must make sure that the prescribing of therapeutic swimming does not become routine. Routine treatment is the greatest threat to good treatment in any hospital. The ward physician must know each patient and be aware of any change in his psychiatric status.

At St. Cloud, the general policy at the hospital is to assign all markedly hyperactive and assaultive patients to the pool rather than to the pack room. There are, however, the following exceptions: patients who are debilitated by age, physical handicap or chronic disease; patients with acute infections; patients with convulsive disturbances; patients receiving shock therapy, and patients who are incontinent. Another exception is made in the case of newly admitted patients whose tendencies have not been observed. When these patients require sedation by physical means, they are sent to the pack room where wet packs or continuous tub baths are used. If there is a choice, the latter are usually prescribed because they offer the patients greater freedom and because the patients invariably prefer them.

Therapeutic swimming at St. Cloud is carried out twice daily, five days a week, from 8:30 to 11 a. m. and from 1 to 3:30 p. m. Patients are assigned to the pool for whatever length of time seems advisable each day. Usually, however, it is for one or two full periods. Although these periods may seem somewhat long, they compare with the average duration of other forms of sedative hydrotherapy in use in neuropsychiatric hospitals. If the patients are carefully selected for therapeutic swimming, no difficulty should be encountered with this schedule. The temperature of the pool is maintained at 90 F. There is complete freedom of movement for the patients in the pool, and the implication of punishment and restraint is entirely absent. More or less strenuous activities, such as water ball, relay races and swimming with rubber fins, can be introduced. At St. Cloud, the maximal number of patients allowed in the pool is limited to 18 because the pool is relatively small. Four technicians from the physical therapy department are present at all times during the periods of treatment; these men wear swimming trunks so that they can enter the pool whenever necessary. It is their responsibility to watch the physical condition of each patient carefully and to be prepared to meet any emergency that may arise. The pulse of each patient is checked every hour during the ten minute rest periods in which the patients are permitted to leave the pool and smoke.

As important and as difficult a problem as any is that of keeping the pool clean. Psychotic patients have few inhibitions as far as contamination is concerned. As a prophylactic measure, all patients are escorted to the toilet each hour. The chlorine content of the water in the pool is determined every hour to make sure that it is maintained at the recommended level. Biweekly bacterial counts constitute an additional check. The pool is drained and thoroughly cleaned each week.

Evaluation of the Swimming Program as a Therapeutic Adjunct

In an attempt to evaluate the effect of therapeutic swimming at the St. Cloud Veterans Hospital, a study was made of the daily reports prepared by ward nurses from Aug. 3, 1947, through Feb. 28, 1948. This study was limited to one building which contained about 180 of the most disturbed patients in the hospital and which supplied about nine tenths of the patients who received sedative hydrotherapy.

From each daily report during this period of thirty weeks the following information was obtained: number of patients who received wet packs, continuous tub baths and engaged in therapeutic swimming; number of patients in restraints; and the number of serious disturbances. In addition, the amount of sedative drugs administered during the same period was determined. Weekly averages were computed on the basis of these data.

Information relating to the six weeks prior to Sept. 15, 1947, was included in the survey to indicate typical values before therapeutic swimming was begun. The information of this period does not, however, represent an ideal control, because the patients have more outdoor recreation during this time than during late fall or winter, and as a result are ordinarily less disturbed.

From the assembled data, it was noted that the average number of patients who engaged in therapeutic swimming gradually increased from 14 to about 18 a day. During the same period, the number of patients who received wet packs and continuous tub baths decreased approximately a half.

Soon after the program was started, it was realized that an evaluation of the amount of sedative drugs administered over the period of the survey was important. Until this was done, no conclusions could be reached as to the effect of therapeutic swimming upon the number of patients in restraints or on the number of serious disturbances.

During the first months, therefore, a record was kept of all sedative drugs administered to patients who were receiving wet packs and continuous tub baths and who were engaged in therapeutic swimming. It was hoped that a comparison could be made between the amount of sedation required by patients who carried out therapeutic swimming and the amount required by those who received the other forms of sedative hydrotherapy. However, it was not possible to carry this survey out, because the group of patients was constantly changing and different criteria were used in prescribing the three types of therapy. New patients for whom therapeutic swimming was prescribed received approximately the same amount of sedative drugs as had been administered to those patients whom they replaced. Patients who improved no longer needed any sedation, and thus were omitted from the nurse's record.

Because the ward nurses had reported that a substantial reduction in the use of sedative drugs had occurred, an alternate method of evaluation was then devised. A survey was made of sedative drugs administered to all patients in the building, not only to those patients who were currently receiving sedative hydrotherapy. Special care had to be taken to be sure that the data obtained actually applied to time spent in this building and not to time spent in another section of the hospital. More than 200 records of patients were studied, and the number of doses of paraldehyde and barbiturates was recorded. Although it was realized that clerical errors could enter into such a survey, the weekly averages were considered to be statistically reliable. From this study it became apparent that there was a gradual but definite decrease in the amount of sedative drugs used.

The reduction in the number of patients who required restraints was impressive. During the first week of therapeutic swimming, about 8 patients reported each day to the pool in cuffs or camisoles; a few weeks later only an occasional patient was reporting in restraints. Although there was reason to expect an increase in the number of patients requiring restraints during the winter months, when activities were more limited, there was actually a marked decrease to a level well below the values in the period before therapeutic swimming was begun.

As the program progressed, it became evident that there were fewer and less severe disturbances in the building. This was relatively easy to verify, because all assaultive episodes were reported by the ward nurses on the daily reports. Study confirmed this impression. With fewer disturbances occurring, the nurses tended to report minor episodes. This tendency might account for some slight irregularities observed in the last two months of the survey.

Summary and Conclusions

Both stimulative hydrotherapy, in the form of the needle spray and the Scotch douche, and sedative hydrotherapy, in the form of the wet pack, tub bath or therapeutic swimming, can be utilized to great advantage in the treatment of psychiatric patients. Of these three types of sedative hydrotherapy, therapeutic swimming should be recognized as the most effective. It is particularly indicated in the treatment of the young patients who invariably look upon therapeutic swimming as a recreational activity and upon the wet pack and tub bath as forms of restraint and punishment. However, there is still a definite and important role for the latter forms of sedative hydrotherapy in the treatment of patients for whom therapeutic swimming is contraindicated. On the basis of our experience, we recommended that all psychiatric hospitals be equipped to provide a program of therapeutic swimming for the physical sedation of hyperactive and assaultive patients. Such a program is a sound investment in rational, progressive therapy.

MEDICAL NEWS

Board of Physical Medicine and Rehabilitation Announces New Appointments.

Dr. Walter J. Zeiter was elected as Chairman of the Board. Dr. Alvin B. C. Knudson was elected to serve out the term of Dr. Frank H. Ewerhardt, deceased, and Dr. Earl C. Elkins was appointed to fill the vacancy created by the resignation of Dr. Frank H. Krusen.

New Division Chief for Army SG Office

The appointment of Colonel Emmett M. Smith, MC, as Chief of the Physical Medicine Consultants Division, has been announced by Major General R. W. Bliss, Surgeon General of the Army. The Physical Medicine post has been vacant since the departure last December of Lieutenant Colonel Benjamin A. Strickland, Jr., MC, for the U. S. Air Force School of Aviation Medicine, Randolph Field, Texas. Colonel Smith is now Chief of the Physical Medicine Service at Walter Reed General Hospital, Army Medical Center, Washington, D. C., which position he will retain in addition to his new assignment.

Congress Members on Radio

Dr. Jessie Wright and Dr. Samuel Sherman, Congress members, presented the subject "Physical Medicine and Rehabilitation" as a part of the radio program "Your Physician Speaks," which is sponsored by the Allegheny County (Penna.) Medical Society, at 10:15 p. m., over station WCAE.

Dr. Knudson Appointed

Dr. Alvin B. C. Knudson, has been appointed Associate in Physical Medicine, George Washington Universtiy.

The Council on Physical Medicine Becomes the Council on Physical Medicine and Rehabilitation

In 1944 it became apparent that Physical Medicine should include not only the employment of physical agents for therapy but also the employment of physical agents for diagnosis, and when

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ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

.·. EDITORIALS .·.

DIAGNOSTIC PHYSICAL MEDICINE

Physical medicine, which in its beginning was purely therapeutic, now encompasses a number of important diagnostic procedures. This development is one of the main reasons why the term "physical therapy" is no longer appropriate. Such objective diagnostic methods are necessary to sound scientific progress in any branch of medicine. They are essential tools for clinical research.

The important diagnostic procedures employed in physical medicine are manual muscle testing, functional testing of the activities of daily living, electrical muscle testing including chronaximetry, electromyography, goniometry, oscillometry and skin and deep temperature determinations. These various diagnostic procedures are important both in completing the initial diagnosis and in recording progress.

The various tests for determining the status of the neuromuscular mechanism supplement each other. Manual muscle testing, chronaximetry, and electromyography may all be used on the same patient in order to obtain a complete picture of the pathological state of impaired musculature. It should be emphasized that these tests in no way replace or detract from the importance of the general physical, the neurologic, or the laboratory examinations. They are simply further helps in the diagnostic service which we are able to furnish to our patients.

The recent emphasis on rehabilitation of the injured and chronically ill has made testing methods necessary. Rusk and Deaver have, therefore, developed a system of simple tests for evaluating the disabled patient's proficiency in performing the activities inherent in daily living. These tests furnish a base line from which to start the rehabilitation program.

The interest of the physiatrist in orthopedic conditions and in the rheumatic diseases has resulted in a system of joint measurements. Goniometry is an essential feature of the program for the handling of these conditions. Likewise the peripheral vascular diseases are of importance in the field of physical medicine. The diagnostic service which we may render to these patients consists of oscillometry and skin temperature determinations.

The attention of our readers is directed to the excellent presentation on electromyography by Golseth and Huddleston[1] in this issue of the ARCHIVES. One of the discussants has appropriately described the language of this paper as "crystal clear." The authors have presented the physiologic background and the clinical applications of electromyography in a most interesting manner.

1. Golseth, J. G., and Huddleston, O. L.: Electromyographic Diagnosis of Lower Motor Neuron Disease, Arch. Phys. Med. 30:495 (Aug.) 1949.

COLONIC IRRIGATION

During the past decade there has been little or no mention of colonic irrigation in the medical literature. Previously there was considerable controversy concerning the procedure. Many physicians, disgusted by the exploitation of the treatment by laymen and other unqualified persons, would have nothing to do with it. Unfortunately, some physicians became overenthusiastic about irrigation of the bowel and used it in a wide variety of local and systemic diseases. Controlled clinical study of the procedure was rare, but clinical impressions were plentiful.

Several well known physicians were advocates of colonic irrigation. Bastedo[1] recommended the treatment in mucous colitis, rheumatism, neuritis and certain secondary anemias in which a focus of infection was suspected to reside in the bowel. Soper,[2] on the other hand, took the opposite view and considered the treatment of doubtful value, of no lasting benefit[3] and often injurious to the mucosa.

Friedenwald and Morrison viewed colonic irrigation as hydrotherapy applied to the interior of the bowel. Cold water could be used as a tonic measure or warm water, for relaxation. They recommended the use of the treatment in dyschesia, in selected cases of constipation, for the removal of mucus and bacteria from the bowel, as a diagnostic aid in preparation for roentgen studies and proctoscopic and sigmoidoscopic examination, and as a diagnostic and therapeutic aid in suspected obstruction.

Pemberton,[4] Snyder, Traeger, et al.[5] Wyatt[6] and others employed colonic irrigation in the treatment of the chronic arthritides. Marshall[7] and Kaiser[8] advocated its use in the treatment of dementia praecox, depressive psychoses and psychoneuroses and claimed a high percentage of improvement in these cases.

De Rivas[9] found Entameba histolytica, Oxyuris vermicularis, Trichomonas, Chilomastix and other parasites susceptible to temperatures which the mucosa of the bowel would tolerate. He advocated irrigation of the colon with a 1 to 5000 solution of copper sulphate at a temperature of 45 to 47 C. retained for five to fifteen minutes. The treatment was repeated three times weekly for two weeks, twice weekly for the next two weeks and then once weekly for two or three months. The De Rivas method has not been reported on by others.

Krusen[10] reviewed the current literature in 1936 and found little clear cut evidence, among the conflicting opinions expressed by various advocates and opponents of colonic irrigation, in favor of its employment. He did admit, however, that the treatment might be of value in some cases of chronic arthritis and, occasionally, for the removal of retained fecal matter.

In addition to the indications already mentioned, Hibben[11] suggested the use of colonic irrigation in the removal of fecal impactions, and in the treatment of diverticulosis and diverticulitis. The writer has found the procedure

1. Bastedo, W. A.: Colon Irrigations, J. A. M. A. **98**:734 (Feb. 27) 1932.
2. Soper, H. W.: Colon Irrigations, J. A. M. A. **98**:1677 (May 7) 1932.
3. Friedenwald, J., and Morrison, S.: Value, Indications, Limitations and Technic of Colonic Irrigation, M. Clin. North America, May, 1935, p. 1611.
4. Pemberton, Ralph: Arthritis and Rheumatoid Conditions, ed. 2, Philadelphia, Lea and Febiger, 1935.
5. Snyder, R. G.; Traeger, C. H.; Fineman, S., and Zoll, C. A.: Colonic Stasis in Chronic Arthritis, Arch. Phys. Ther. **14**:610 (Oct.) 1933.
6. Wyatt, B. L.: Chronic Arthritis and Fibrositis, New York, William Wood and Company, 1933.
7. Marshall, H. K., and Thompson, C. E.: Colon Irrigation in the Treatment of Mental Disease, New England J. Med. **207**:454 (Sept. 8) 1932.
8. Kaiser, N. W.: Colonic Therapy in Mental Disease, Ohio State M. J. **26**:510 (June) 1930.
9. De Rivas, Damaso: The Effective Treatment of Amebic Dysentery by Means of Intracolonic Heat, New Internat. Clin. **1**:220 (Mar.) 1933.
10. Krusen, F. H.: Colonic Irrigation, J. A. M. A. **106**:118 (Jan. 11) 1936.
11. Hibben, J. S.: Irrigation of the Colon, Arch. Phys. Ther. **21**:33 (Jan.) 1940.

useful in diverticulitis of the bowel which is causing discomfort. The irrigation is followed by the instillation of 3 or 4 ounces of a suspension of bismuth subcarbonate in a solution of tragacanth.

In the writer's opinion, simple constipation is rarely an indication for irrigation of the colon. This condition can usually be overcome by education of the patient as shown by Brailey.[12] Regular habits of eating and sleeping, a half hour of vigorous exercise daily, at least eight glasses of fluid per day, the avoidance of cathartics and the establishment of a regular bowel habit, will, in the majority of cases correct simple constipation.

Friedenwald and Morrison[3] listed the following contraindications to colonic irrigation: severe cardiac disease, advanced arteriosclerosis, aneurysm, severe anemias, high fevers, exophthalmic goiter, gastrointestinal ulceration, hemorrhage or perforation, anal disease such as hemorrhoids, pruritis, eczema, or stricture and great debility from any cause.

In this issue of the ARCHIVES will be found a lucid article on colonic irrigation by Molander.[13] Indications, contraindications, methods, precautions and procedures are all carefully discussed. If these instructions are followed, there should be no complications encountered and the results should be satisfactory.

12. Brailey, A. G.: Treatment of Constipation, New England J. Med. **216**:697 (Apr. 22) 1937.
13. Molander, C. O.: Colonic Irrigation, Arch. Phys. Med. **30**:523 (Aug.) 1949.

Medical News

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it also became apparent that that branch of the specialty known as occupational therapy should also come within the purview of the Council, the Council on Physical Medicine recommended that its name should be changed from "the Council on Physical Therapy" to "the Council on Physical Medicine." The Board of Trustees of the American Medical Association approved this change in name in 1945.

During World War II and in this postwar period, the close relationships between physical medicine and the rapidly growing field of rehabilitation have become increasingly apparent. In our governmental hospitals and to an ever increasing extent in our civilian hospitals the services in physical medicine and rehabilitation have become inextricably conjoined. In the Army after World War II there was established a Physical Medicine Consultants Division which directs the activities not only in physical medicine but also in rehabilitation and physical reconditioning in all Army general hospitals. In the Veterans Administration, a central Physical Medicine Rehabilitation Service has been established which coordinates and directs the work in physical medicine and rehabilitation in all Veterans Administration hospitals. In our civilian teaching institutions, combined residencies in physical medicine and rehabilitation are being offered in rapidly increasing numbers.

Likewise, when, during its annual meeting, the Council on Physical Medicine conferred with representatives of the Council on Medical Education and Hospitals, it was agreed that the fields of physical medicine and rehabilitation were so closely related that it would be inadvisable to offer separate residencies or fellowships in these two branches. Therefore, it was the joint opinion of those present at this conference that a movement toward the development of more combined residencies in physical medicine and rehabilitation should be encouraged. It was agreed that those who direct existing approved residencies in physical medicine should be encouraged to include more complete instruction in rehabilitation and that the establishment of separate residencies in rehabilitation should not be approved.

It has become increasingly apparent to the members of the Council on Physical Medicine that the close relationships between physical medicine and rehabilitation must be recognized and that, while neither special field can or should absorb the other, the many interconnections should be indicated. There are phases of physical medicine (as in the definitive treatment of acute diseases by physical agents) which cannot be called rehabilitation and there are phases of rehabilitation (as in the psychosocial readjustment of the disabled person) which cannot be called physical medicine. Yet, for the most part, physical medi-

cine and medical rehabilitation are closely interdigitated and it is apparent that it would be illogical for either physical medicine or medical rehabilitation to go its separate way.

Furthermore, the Council has become more and more involved with the various aspects of rehabilitation. The members of the Council desire to indicate that there are other special fields of medicine in which a similar joint terminology has been found essential. These include "dermatology and syphilology," "obstetrics and gynecology" and "psychiatry and neurology."

For these reasons, after mature deliberation, the Council on Physical Medicine has recommended to the Board of Trustees of the American Medical Association that, owing to the inevitable march of progress and the expansion of its interests into the field of rehabilitation, its name be changed once more and that hereafter it be designated as "the Council on Physical Medicine and Rehabilitation." It has been concluded that this is a fully logical and in fact highly desirable change, which would indicate more specifically the present status of the expanding field of medical activity with which the Council is concerned.—[Rep. J. A. M. A. 140:292 (May 21) 1949.]

Pennsylvania Academy of Physical Medicine

At a regular monthly meeting of the Pennsylvania Academy of Physical Medicine, Dr. William Bierman presented a paper on "The Diagnosis and Treatment of Peripheral Nerve Paralysis." War Department Film "Therapeutic Exercises in Peripheral Nerve Injuries" and "Electrodiagnosis" were presented. Discussion was opened by Dr. Frederic H. Lewey of Philadelphia.

Additions to the Staff of the American College of Surgeons

Recent additions to the staff of the American College of Surgeons, as Assistants in the Hospital Department, include Dr. George C. Erickson, Dr. Dorothy Bartels, and Dr. Jose Gonzalez. Dr. Harold R. Hennessy has been added to the staff of the Department of Clinical Research to assist in the program of approval of cancer clinics and cancer detection centers.

Dr. George C. Erickson was for two years Assistant Superintendent of the Worcester City Hospital, Worcester, Massachusetts. He received his medical degree from Tufts College Medical School in 1931. Dr. Dorothy Bartels received her medical degree from the University of Illinois Medical School in 1946. Dr. Jose Gonzalez has a Bachelor of Science degree from the University of Mexico, 1934; a degree in medicine from the University of Mexico Faculty of Medicine, 1943. In 1946 he returned to Mexico City to complete the plans for a 500-bed private hospital and to raise the money for financing the project which is at present in abeyance. Dr. Harold R. Hennessy received his degree in medicine from the University of Minnesota Medical School in 1930.

Apparatus Accepted

Isolette Infant Incubator Model C-35. — The Isolette Infant Incubator Model C-35 has the approval for listing by Underwriters' Laboratories, Inc. The device houses infants requiring control of temperature, humidity and oxygen content of their environment. A weighing scale is included permitting the infant to be weighed without removing it from the incubator. The Council on Physical Medicine and Rehabilitation voted to include the model in its list of accepted devices.

Comfort Pillow. — The Comfort Pillow is designed to be used by expectant mothers for the support of the abdomen during sleep. The Council on Physical Medicine and Rehabilitation voted to include this in its list of accepted devices.

Not Accepted by Council

Alphatron Radon Ointment. — The Alphatron Radon ointments first introduced to the Council were found to be irregular in composition and distribution without adequate protection for handlers and users. Recent promotional literature suggests its use in treating irradiation ulcers, chronic eczema, arthritis, etc. Because of lack of further evidence for beneficial results, the Council on Physical Medicine and Rehabilitation voted not to include this item in its list of accepted devices.

The Army Physical Therapy Training Program

On May 13, 1949 the students in the Physical Therapy Training Course at the Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston, Texas, completed the first phase of their training. These ten reserve officers in the Women's Medical Specialist Corps are now assigned to the hospitals where they will receive the second six-months phase of their training which will consist of further didactic instruction and supervised clinical practice. The next Physical Therapy Training Course will start at the Medical Field Service School on November 7, 1949 and will be preceded by an eight weeks basic course of orientation to army regulations, customs and procedures.

The twelve-week physical therapy training program for enlisted personnel began in May at the Medical Field Service School. These physical therapy technicians are being trained in such elementary assistive procedures as may be satisfactorily performed under the direction and supervision of the physical therapist. The purpose of the program is to increase the number of trained auxiliary personnel in army physical therapy sections so that the physical therapist may devote a greater amount of her time to the more skilled professional procedures.

Rehabilitation of the Physically Handicapped — An Advanced Course in Rehabilitation Methods for Physical Therapy Technicians

Knowing of the interest in the subject, there follows a description of the six-weeks course offered this spring at the New York University-Bellevue Medical Center, Institute of Rehabilitation and Physical Medicine, in conjunction with New York University School of Education, in rehabilitation of the physically handicapped.

It is planned to repeat this special course four times during the 1949-1950 school year:

October 3, 1949 through November 11, 1949.
January 2, 1950 through February 10, 1950.
February 20, 1950 through March 31, 1950.
April 10, 1950 through May 19, 1950.

Further information and application blanks for the course may be obtained by writing to Edith Buchwald, R.P.T., Director of Rehabilitation Courses for Physical Therapists, Institute of Rehabilitation and Physical Medicine, 325 East 38th Street, New York 16, New York.

Course Description

Course 180.451 Rehabilitation for the Physical Handicapped (6 week course). The course is divided into three sections:

I. Severe Disabilities and Their Rehabilitation: All aspects of orthopedic, medical, surgical cases and their specific problems in rehabilitation are discussed. The lectures and demonstrations are given by physicians, rehabilitation and other medical specialists. Instructors: Dr. H. Rusk, Dr. G. Deaver, Dr. D. Covalt; associates, staff of the Institute of Rehabilitation and guest lecturers.

II. Skills and Methods of Functional Activities: Theory, technic, teaching methods, tests and individual programs of Functional Activities will be discussed, demonstrated and practiced. Clinical observation will be included. Instructor: E. Buchwald, M.A., R.P.T.T.

III. Clinical Experience: Students will work with patients under supervision at the Institute of Rehabilitation and Physical Medicine. Instructor: E. Buchwald and staff.

Course Details

Requirements: Open to Certified physical therapists who have the approval of the Curriculum Director.*

Credit: Four points of either undergraduate or postgraduate credit.

Hours: Mondays, Wednesdays and Fridays 9:00 A.M. to 4:00 P. M.; Tuesdays and Thursdays 9:00 A. M. to 5:30 P. M.

Dates: October 3, 1949 through November 11, 1949; January 2, 1950 through February 2, 1950; February 20, 1950 through March 31, 1950; April 10, 1950 through May 19, 1950.

Fees: Tuition $62.00 ($15.50 per point); Registration $3.00; Laboratory $2.00. Qualified veterans may enroll in the course under the provision of P. L. 346 or P. L. 16.

Application: Applications and requests for further information may be submitted to Miss Edith Buchwald, Director of Rehabilitation Courses for Physical Therapists, Institute of Rehabilitation and Physical Medicine, 325 East 38th Street, New York 16, New York.

Uniforms: White uniforms, white shoes and black slacks and white blouses.

Housing: Arrangements have been made through the Institute for rooms in nearby hotels at $13.75 weekly per person, double rooms; a few singles may be available.

* Physical Therapists who are members of either the American Registry for Physical Therapy Technicians and/or members of the American Physical Therapy Association.

"Polio" 1949

Weekly reports from the United States Public Health Service indicate 3,197 cases of infantile paralysis from January 1 through July 2, 1949. The American Physical Therapy Association in cooperation with the National Foundation for Infantile Paralysis is recruiting physical therapy technicians to work from three to six months in epidemic areas. If any physical therapy technician, who is a graduate of an approved school or a senior registrant of the American Registry of Physical Therapy Technicians or a member of the American Physical Therapy Association is available for such an assignment, he should phone New York, JUdson 6-2932 collect. Details in regard to these positions may be secured from "Polio" Recruitment Service, American Physical Therapy Association, 1790 Broadway, New York City. Physical therapy technicians who are not permanently employed should give particular consideration to accepting at least a three months assignment to contribute to this much needed care.

Air Force Medical Reserve Is Established

General Hoyt S. Vanderberg, Chief of Staff, U. S. Air Force, announced today that applications are being received for commissions in the newly created Air Force Reserve. Physicians, dentists, nurses, and other medical personnel who served with the Army Air Forces during the war may make application through the Air Adjutant General, U. S. Air Force, in Washington.

New Manager Assigned to Jefferson Barracks

Veterans Administration has announced that Dr. John W. Claiborne, chief medical officer in the V-A Regional Office at Nashville, Tennessee, became manager of the V-A hospital at Jefferson Barracks, Missouri, effective July 24.

Obituary

It is with regret we announce the deaths of two of our Congress members: Dr. Jacob Byer of New York City and Dr. Morris Rubenstein of Whipple, Arizona.

BOOK REVIEWS

POLIOMYELITIS. PAPERS AND DISCUSSIONS. Presented at the First International Poliomyelitis Conference. Compiled and Edited for the International Poliomyelitis Conference. Fabrikoid. Pp. 353 with 93 figures. Price, $5.00. J. B. Lippincott Co., 227-231 S. 6th St., Philadelphia 5, 1949.

All who had the privilege of attending the first international conference on poliomyelitis sponsored by the National Foundation were truly impressed with the excellence of the presentation of the formal papers and the discussions. Practically every country in the world, except those dominated by Russia, were represented by the most eminent authorities on all the various aspects of poliomyelitis.

This book covers the ten plenary sessions beginning with session one on the importance of poliomyelitis as a world problem and continuing with the other sessions dealing with the management of a polio patient during the early stage and convalescent stage, rehabilitation, bulbar poliomyelitis, immunology and chemotherapy, pathogenesis, etc. The chapters on the convalescent stage should interest physiatrists and technicians particularly. The paper presented by Dr. A. L. Watkins on progressive disabilities in poliomyelitis is an analysis of the different types of neuromuscular dysfunction seen in these patients and a correlation of the observations observed clinically with those investigated by electromyography. It is a scholarly presentation and contributes a great deal of practical and scientific knowledge.

The excellent article by Dr. William T. Green on the management of the convalescent stage is complete and helpful, and would certainly meet the approval of anyone who has had sufficient experience in this phase of polio treatment. It is a bit disturbing in this day to read the statement at the close of the article where he states that "treatment during the convalescent stage should ideally be supervized from the start by someone skilled in the treatment of musculoskeletal diseases in general, and poliomyelitis in particular, . . . this individual would ordinarily be an orthopedic surgeon, although it *might* be a physiatrist." (The italics are the reviewer's.)

The inclusion of the discussions that followed each session is very much worth while and alone would justify the purchase of the book. Too often discussions are senseless and a waste of time but in the manner that this part was coducted may have been the most instructive and stimulating; for example, following Dr. Green's paper two discussers frankly consider the question of prolonged therapy in muscles rated zero or trace, the remarks about the functions and boundaries of the psychiatrist and the psychologist, the opinions about electrical stimulation as presented by Drs. Bennett and Northway, and numerous others.

The various types of surgical procedures for the specific problems that occur are briefly condensed by Dr. Barr in the chapter on rehabilitation. He most adequately shows how the ingenuity and skill of the orthopedic surgeon has supplied marvelous resources which overcome the disabilities of polio. Dr. Barr aptly expresses the advances and cause for optimism in his statement "the surgical possibilities of 50 years ago became the triumphs of 20 years ago and are the commonplace accepted procedures of today. The art of the brace fitter seems to have yielded its place to the surgical art of the scalpel." Here again the discussion following this paper answers numerous questions and supplies pertinent information that is usually not considered in the formal presentation of a paper.

This book should appeal to everyone who cares for patients with anterior poliomyelitis which should include anyone in physical medicine. Those who were fortunate to be present at the conference will want a copy of this work and the others will surely profit by reading and studying this book.

THE ISSUE OF COMPULSORY HEALTH INSURANCE: A STUDY PREPARED AT THE REQUEST OF SENATOR ALEXANDER SMITH, CHAIRMAN OF THE SUBCOMMITTEE ON HEALTH OF THE SENATE COMMITTEE ON LABOR AND PUBLIC WELFARE. By *George W. Bachman* and *Lewis Meriam*. Paper. Pp. 271. Brookings Institution, 722 Jackson Pl., N. W., Washington 6, D. C., 1948.

This timely study was prepared by the Vice-President of Brookings Institution and an experienced physician in experimental medicine and public health at the request of the chairman of the subcommittee on health of the Senate Committee on labor and public health. It attempts to answer these important questions: How bad are health conditions in the United States? Are available medical care statistics dependable? Can American families afford to pay for medical care? Is compulsory health insurance desirable? How would practitioners be affected? Would the quality of service be affected? Would administrative costs be heavy?

The evidence for the conclusions reached comprises all but 14 pages of the 267 and, although the data obtained is known to be not all-inclusive, it represents an honest effort to derive facts upon which to base fair, practical conclusions. All physicians and the lay public would do well to familiarize themselves with the important information contained here before drawing conclusions on this controversial subject.

COMPARATIVE PHYSIOLOGY. By *Bradley T. Sheer*, Ph.D., Assistant Professor of Biochemistry, University of Southern California, Los Angeles. Cloth. Price, $6.00. Pp. 563, with 72 illustrations. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16; Chapman & Hall, Ltd., 37-39 Essex St., Strand, London, W. C. 2, 1948.

The author has written a textbook suitable for an advanced university course in comparative physiology. Such a course is a logical complement to courses in general and cellular physiology. Comparative physiology might well occupy a similar position in the premedical curriculum as does comparative anatomy. It is presumed that the student will be familiar with the basic principles of physics and chemistry. Chapter one deals with the physiology of animals; chapter two, protozoa; chapter three, multicellular acoelomate animals; chapter four, mollusca; chapter five, annelida; chapters six and seven, arthropoda; chapter eight, echinodermata; and chapters nine and ten, vertebrata. It is an unusual method of presentation and each chapter discusses in turn nutrition, feeding, digestion, circulation, respiration, metabolism, excretion, regulation of the internal environment and the neuromuscular system. The material is well presented, authorative and well written. This volume should be valuable to anyone interested in the field of physiology.

FRACTURES AND ORTHOPAEDIC SURGERY FOR NURSES AND MASSEUSES. By *Arthur Naylor*, Ch.M., M.B., M.Sc. (Sheff.), F.R.C.S. (Edin.), Honorary Orthopaedic Surgeon, Bradford Royal Infirmary and Bradford Children's Hospital; Orthopaedic Surgeon, Bradford Municipal General (St. Luke's) Hospital and Bradford Education Committee; Temp. Major, Orthopaedic Specialist, R.A.M.C. Foreword by Ernest Finch, M.D., M.S. (Lond.), F.R.C.S. (Eng.), Consulting Surgeon, Royal Infirmary and Hospital Sheffield, Late Professor of Surgery, University of Sheffield. Fabrikoid. Pp. 296 with 261 illustrations. Second edition. Price, $5.00. The Williams & Wilkins Company, Mount Royal and Guilford Aves., Baltimore 2, 1948.

This is a fairly short, concise summary of the most common orthopedic conditions and their treatment. The title is ineptly chosen for American readers as the term "masseuses" is not a synonym here for physical therapists.

The author is to be commended for one feature so lacking in most texts of orthopedics. Several pages are devoted to restoration and maintenance of functional activity including a discussion of the procedures in physical medicine as well as their application to patients. Methods for physical treatment are listed as: (1) passive physical therapy including heat and massage; (2) remedial exercises including resistive type; (3) organized games; (4) postural and walking exercises; and (5) bed exercises.

In every condition the author not only stresses the importance of physical therapy, but outlines definite measures. He makes other noteworthy points such as, "Following meniscectomy, exercises are continued until muscle function (of quadriceps) equals that of the unaffected leg."

However, in criticism of the author, he sometimes makes flat statements which are not generally accepted and might mislead nurses and physical therapists for whom the book is intended. For example, in the treatment of poliomyelitis, "When the spontaneous muscle recovery ceases, muscle training and reeducation should commence." Again, "Mental defect is present in varying degrees in all cases of spastic paralysis (cerebral palsy)." Furthermore, his antagonism to "Sister Kenny's Methods" seem to be based on prejudice, and her concept of the disease is not treated fairly. In general this is a good book for nurses and physical therapists and very easy to read.

YOUNG-MILLER'S HANDBOOK OF ANATOMY. Revised by *George W. Miller*, M.D., F.A.C.S., Professor of Anatomy, Temple University Dental School, Philadelphia, Pa.; Surgeon, Norristown State Hospital, Norristown, Pa.; Surgeon Emeritus, Montgomery Hospital, Norristown, Pa.; Consulting Surgeon, Sacred Heart Hospital, Norristown, Pa. Ninth edition, with 142 illustrations, 4 in color. Fabrikoid. Pp. 495. Price, $5.50. F. A. Davis Company, 1914-16 Cherry St., Philadelphia 3, 1948.

This is the ninth edition of a useful teaching text of anatomy which is designed to give the student only the essential basic facts of anatomy in concise detail. In order for a student to make proper use of this book he must become a thinking partner with the text to master the subject, rather than use simply as a reference.

In this edition the text has been thoroughly revised and expanded. The errors have been corrected. The nomenclature has been made to conform to the B. N. A. recommendations, and the illustrations have been improved. The book is recommended only to teachers of anatomy as a possible teaching text.

YOUR CHILD OR MINE. The Story of the Cerebral-Palsied Child. By *Mary Louise Hart Burton* in collaboration with *Sage Holter Jennings*. Fabrikoid. Pp. 64, with illustrations. Price, $1.25. Coward-McCann, Inc., 2 West 45th St., New York 19, 1949.

This small volume gives the history of six children with cerebral palsy of different types. It shows what can be accomplished by proper medical care and the importance of adequate social contacts in the community. It is written for the lay individual for educational purposes and should also serve as inspiration to parents of the cerebral palsied.

PAIN SYNDROMES. Treatment by Paravertebral Nerve Block (Formerly Segmental Neuralgia in Painful Syndromes). By *Bernard Judovich*, M.D., Instructor in Neurology, Graduate School of Medicine, University of Pennsylvania; Physician in Charge, Neuralgia Clinic, Graduate Hospital, Philadelphia, and *William Bates*, M.D., F.A.C.S., F.I.C.S., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania. Foreword by Joseph C. Yaskin, M.D., Professor of Neurology, Graduate School of Medicine, University of Pennsylvania. Third Edition. Cloth. Price, $6.00. Pp. 374, with 181 illustrations. F. A. Davis Company, 1914-16 Cherry Street, Philadelphia 3, 1949.

Although this work is by no means a complete text on the clinical management and treatment of pain, it is by far the most useful and complete monograph available on the subject. Included in the text is a discussion of the various types of segmental neuralgias and painful syndromes, and an excellent presentation of the infiltration technic with procaine, Cooley's fluid, pitcher plant distillate and ammonium salt solution for the relief of pain and tenderness. The text is thoroughly supplemented with case histories in which infiltration technics were employed successfully, and ample photographs and artists' drawings are displayed to illustrate the various topics under discussion.

In this edition the text has been revised and enlarged. The chapters on brachial plexus neuralgia and scalenus anticus syndrome have been reedited. Endometriosis as a cause of backache is presented with case histories. The intravenous use of procaine as a method of pain control is presented with indications and technic of administration. The chapters on atypical facial pain and the technic for aborting attacks of migraine have been added.

This book will prove to be of great interest to the physiatrist since in this specialty one frequently encounters patients with undiagnosed pain. Not only is the book helpful in improving diagnostic acumen, but also, for those who are interested, it offers an adequate tool for controlling pain.

THE RENAL ORIGIN OF HYPERTENSION. By *Harry Goldblatt*, M.D., C.M., Director, Institute for Medical Research, Cedars of Lebanon Hospital, Los Angeles. Publication Number 14, American Lecture Series. A Monograph in American Lectures in Pathology, edited by Paul R. Cannon, M.D., Professor of Pathology, University of Chicago, Chicago. Fabrikoid. Price, $2.75. Pp. 126, with 38 illustrations. Charles C Thomas, 301-327 E. Lawrence Ave., Springfield, Illinois, 1948.

The investigations which lead to the renal theory of essential hypertension are presented in this small but valuable volume. This book tells of the work of Doctor Goldblatt and his associates beginning in 1928 when they were able to reproduce the arterial and arteriolar sclerotic lesions in the kidneys by clamping the main renal artery thereby reducing the intraglomerular capillary pressure and the blood flow to the kidneys. The physiologic changes that occurred when various procedures were used are described in the different chapters; for example, effect on blood pressure of moderate constriction of the main artery of only one kidney; effect on blood pressure of great constriction of both main arteries; the malignant phase of experimental hypertension; pathogenesis (mechanism of development) of experimental renal hypertension, etc. The possibility of a humoral mechanism for renal hypertension is discussed in the separate chapters on renin, hypertensinogen, hypertensin, and hypertensinase.

Other theses for the production of hypertension are briefly considered with particular attention to the one postulated by Page and his collaborators. This tremendous subject is thoroughly covered in only 116 pages which in itself is quite an accomplishment. Doctor Goldblatt has analyzed the material in a critical manner and his interpretations should aid in a clearer understanding of this most complex subject. With his typical modesty he apologizes for presenting still another book on hypertension but justifies his efforts in that it may interest those persons who would read a short monograph rather than the voluminous original papers or other large books on hypertension. This book definitely fulfills this purpose.

RONALD ROSS: Discoverer and Creator. By *R. L. Mégroz*. With a preface by Osbert Sitwell. (Reprinting), Cloth. Price, $3.00. Pp. 282, with 4 illustrations. The Macmillan Company, 60 Fifth Ave., New York 11; George Allen & Unwin, Ltd., 40 Museum St., London, W.C.1, 1948.

The discoveries of Sir Ronald Ross in the field of tropical medicine are known the world over and his services to humanity have been fittingly acknowledged by his reception of the Nobel Prize. But it is not generally known that these activities display only one facet of his many-sided genius and that he has written some amazing novels, besides having made contributions to poetry and music and being a keen mathematician.

Part I of this volume is a biography of Ross. Born and educated by English parents in India, he entered the Indian Medical Service at the age of seventeen, receiving his medical education at St. Bartholomew's Hospital at London. He wrote his first poems as a medical student there. Beginning his medical service in India, he became interested in mosquitos but at the same time kept on writing prose-romance and with the publication of some of these writings, considered for a while changing to literature for a profession. But he also began studying blood specimens of malarial patients and after much painstaking work in 1897, finally unraveled the cycle of the malarial parasite. A disconcerting incident came when the Italian Grassi made a determined attempt to "pirate" Ross' discovery, but truth prevailed and in 1902 Ross received the Nobel prize. His discovery made possible the subsequent work of Gen-

eral Gorgas in combating yellow fever in Panama. Part II of this volume is dedicated to the literary work of Ross which is most varied. His poetry in verse can be classified under the heads of Satire, Drama and Lyric. Many passages of Ross' novels are expressive as poetry and his descriptive prose shows immense creative energy. In addition to the illustration of these talents by many passages from his writings, a chapter is also devoted to his work as a mathematician both in pure science and by introducing the various branches of mathematics into his researches in biology and medicine. No wonder that Castellani described Sir Ronald Ross as probably the greatest genius living in our time. The reading of Mégroz' biography will reveal to the world a balanced picture of one of the most remarkable personalities of modern times.

THE BUSINESS SIDE OF MEDICAL PRACTICE. By *Theodore Wiprud,* Executive Director and Secretary of the Medical Society of The District of Columbia and Managing Editor of the *Medical Annals of the District of Columbia.* Second Edition. Pp. 232, with 22 figures. Price, $3.50. W. B. Saunders Company, West Washington Square, Philadelphia 5, 1949.

In the twelve years since the first edition of this book appeared many physicians have used it to advantage. Medical schools would do their students a real service if they would insist that they read this book and physicians who have been out in practice for years would profit by periodic rereading. Medical meetings would be a greater success and pleasure if before every meeting the chairman would be forced to read beforehand the chapter entitled "On Conducting a Meeting" or if the speaker would read the chapter on public speaking. Books of this type are not quickly outmoded for the advice given years ago is still applicable today. However, medical practice is being altered by social changes even though it is not too obvious. The author recognizes this in adding new chapters on "Opportunities for Medical Leadership," "Group Medical Practice" and "The Doctor Looks to the Future."

CARDIOVASCULAR DISEASE IN GENERAL PRACTICE. By *Terrence East,* M.A., D.M. Oxon., F.R.C.P. Lond. Physician and Physician-in-Charge of Cardiological Department, King's College Hospital. Third Edition. Fabrikoid. Pp. 208, with 34 illustrations. Price, 15s, net. H. K. Lewis & Co., Ltd., 136 Gower Street, London, W.C. 1, 1949.

The second edition appeared in 1946 which is a relatively short time for another edition, however, the advances in cardiology are sufficiently numerous to justify this new edition The author has revised and added new sections on heart failure and its treatment, hypertension, coronary heart disease, congenital defects, pulmonary disorders and peripheral failure. This is a small practical volume which makes no attempt to be exhaustive (not even electrocardiography is included) but it is a workable book on the more frequently encountered cardiac diseases and disorders and should be helpful to the busy practitioner.

AN EVALUATION OF SELECTED SCHOOLS OF NURSING WITH RESPECT TO CERTAIN EDUCATIONAL OBJECTIVES. By *Helen Nahm,* Director of the Division of Nursing Education, Duke University, Durham, N. C. With a foreword by Walter W. Cook. Applied Psychology Monographs of the American Psychological Association. Paper. Price, $2.00. Pp. 97. Published for the American Psychological Association by Stanford University Press, Stanford California; Oxford University Press, Amen House, Warwick Sq., London, E.C. 4, 1948.

THE ORGANIZATION AND ADMINISTRATION OF INTRAMURAL SPORTS. By *Louis E. Means,* Professor of Physical Education and Director of the Division of Physical Education and Intramural Sports, University of Nebraska. Fabrikoid. Price, $5.75. Pp. 442, with 214 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1949.

During the recent war gymnastics in the form of physical conditioning was closely allied with the field of physical medicine, but since the war's termination the two fields of endeavor have followed divergent paths. Actually gymnastics as individual and group physical activities could be considered a prophylactic form of physical medicine. This text is a presentation of various methods of organizing both individual and group sports for various age groups. It is clearly written, well illustrated and extensively documented with references to the literature. It will be a valuable addition to the library of those physiatrists who are closely associated with educational institutions and departments of physical education.

DIABETES MELLITUS AND EXERCISE. A Physiologic Study of Muscular Work in Patients with Diabetes Mellitus. By *E. O. Erreboe-Knudsen,* Paper. Pp. 152. G. E. C. Gads, Forlag, Vimmelskaftet 32, Copenhagen, 1948.

This monograph presents a series of exercise experiments on patients with diabetes mellitus in which the question of experimental conditions has been given careful consideration. In Denmark during the past two decades, important contributions have been made to the study of the behaviour of the blood sugar in connection with muscular activity in normal individuals. Various authors showed that the course of the blood sugar curve during exercise in normal experimental subjects is dependent on the training, to a lesser degree on the magnitude of the muscular work. The diet is, moreover, of significance, and the size and the ease of mobilization of the carbohydrate depots seem important, too. The better the regulation, the smaller are the changes found in

the blood sugar level during exercise. If carbohydrate is administered at the same time as the exercise begins, the blood sugar increase is less than in the case of no exercise. If the exercise is started one hour after carbohydrate ingestion, the blood sugar level may decline to such an extent that hypoglycemic symptoms occur. If carbohydrate is ingested after the exercise, the increase in blood sugar is greater than if no work had been performed.

The general idea regarding the blood sugar during exercise in fasting diabetics who have not received insulin is, as Joslin points out, that exercise produces an increase in the blood sugar if the diabetes is but fairly pronounced. The various authors agree that when insulin is administered, exercise has a favorable effect on the diabetic organism in that the blood sugar decreases.

The experimental results of the authors indicate that in relatively mild and medium severe diabetes, glucose ingestion and exercise cause a lowering of the ketone body concentration. In more severe diabetes mellitus one finds no effect on the ketone body concentration, the concentration increasing evenly. The combustion of glucose during exercise is increased in relatively mild or medium severe diabetes in proportion to the resting value, and it further increases with increasing working intensity. The experiments show moreover, that there may occur a deposition of glucose during exercise in these experimental subjects. The efficiency is the same in patients with relatively mild diabetes. The efficiency is the same in patients with relatively mild diabetes mellitus as it is in normal individuals; in more severe cases it declines.

The experiments furnish no final proof in support of either the overproduction or the nonutilization theory, even though, in the opinion of the author, they seem rather to favor the nonutilization theory. They do elucidate some aspects of the mode of reaction of the human diabetic organism during exercise.

HOW TO LIVE LONGER. By *Justus J. Schifferes.* With a foreword by Ralph F. Sikes, M.D. Cloth. Price, $3.00. Pp. 225. E. P. Dutton & Co., 300 Fourth Ave., New York 10, 1949.

The author, although a layman, has for many years been managing editor of a medical journal at a crossroads where medicine and propaganda met and was impressed by the ignorance and indifference that most people exhibit towards scientific information that would save their lives if they only had it in them. He attempts to line up "preventive medicine in action" by presenting an accurate account of the disease hazard to which people in the United States are most likely to succumb. He holds that in order to maintain optimum health everyone should have some practical information about the incidence and mechanisms of the principal causes of death, which he proceeds to enumerate and discuss in order of frequency: heart disease, cancer, "stroke," accidents, kidney disease, pneumonia, tuberculosis, premature birth, diabetes, suicide and syphilis. This is quite a different listing from that of half a century ago. Diseases of childhood and communicable diseases like tuberculosis and pneumonia have declined immensely in importance as killers, while the degenerative diseases, such as heart disease and cancer, have risen in importance both as "personal" and "public health" problems. The facts presented are well documented. Despite its preoccupation with the causes of death, this is a hopeful book. It will tend to eliminate groundless fears about many conditions and offers stimulating as well as informative reading.

MEDICAL EDUCATION. By *Ffrangcon Roberts,* M.D. Cloth. Price, 12s. 6d. Pp. 172. H. K. Lewis & Co., Ltd., 136 Gower St., London, W.C. 1, 1948.

In his introduction the author states that during the past few decades medical education has failed to keep pace with the great expansion of knowledge which has occurred and that it has remained uninfluenced by modern educational methods. "With the constant discovery of new methods of diagnosis and treatment we tend more and more to think of medical education as a training in technic rather than a preparation for something in which the whole personality is concerned. Reform is a question not merely of adding to the curriculum here and subtracting from it there, nor is it to be solved by the provision of new buildings and by subdivision of departments, nor again is it concerned exclusively with the furtherance of research. It is a search for unity and synthesis in a subject which has a natural tendency to disunity and dispersion, a search for the ideal combination of science and empiricism; above all a search for a solution which needs no periodic stimulation but which, being based on fundamental principles, automatically keeps itself alive." He develops this thesis in 21 chapters, the titles of most of which speak for themselves, the science and art of medicine, basic fallacies, the reform of the premedical course, the defects of the preclinical course, the reform of the preclinical course, the limitations of hospital experience, the reform of the clinical course, training in observation. While the contents relate chiefly to educational conditions in Great Britain, there are ample references to and observations of the status of medical education in the United States. This is indeed a stimulating volume on an educational topic of vital importance.

PHYSICAL MEDICINE ABSTRACTS

Characteristics of the Thigh Muscles with a Double Action. J. E. Markee, and Maude Williams.

Federation Proc. 8:106 (March) 1949.

Previously, evidence was presented that muscles which pass over both the knee and hip function as double muscles; one part shortens to move the hip; another part shortens to move the thigh. This different participation of the separately innervated areas of the biceps femoris, semitendenosus, semimembranosus, rectus femoris, sartorius and gracilis occur during (1) direct stimulation of the nerve branches; (2) reflex flexion and crossed extension elicited in decerebrate preparations; and (3) flexion and extension induced by cortical stimulation. In the present investigation, evidence is presented indicating that these thigh muscles which act as double muscles possess the functional characteristics of simple flexor and extensor muscles. That is, one part of the biceps femoris flexes the knee and resembles a simple flexor muscle in that it fatigues rapidly and develops less tension per unit of weight. In addition the development of effective tension occurs through a longer proportion of the range of shortening of the fibers. On the other hand, the part of the biceps femoris which extends the hip resembles muscles which are simple extensors in that this part fatigues less rapidly and develops more tension per unit of weight. In addition the development of tension is more dependent on the length of the fiber in the extensor portion of the muscle. The flexor and extensor portions of the semitendenosus and gracilis, respectively, possess these flexor and extensor characteristics.

Effect of Abdominal Ice Packs and Recovery from Fatigue. W. W. Tuttle; W. P. Happ, and M. Wilson.

Federation Proc. 8:167 (March) 1949.

It has been reported that cold hip baths were employed in Germany during the last World War, in both industry and the air force, to ward off the onset of fatigue and to hasten recovery from it. It is the purpose of this investigation to gain further information relative to the beneficial effects of the local application of cold on recovery from fatigue. The problem was approached by comparing the maximum amount of work a subject would do on a bicycle ergometer in one minute of maximum effort before and after a 10-minute rest, both without and with an ice pack applied to the abdomen during the rest period. Eleven graduate men ranging in age from 25 to 35 years, and in weight from 130 to 200 pounds, served as subjects. A study of the data showed, that in every case, the drop-off in work following a rest period with an abdominal ice pack was significantly less than when the ice pack was omitted. The mean drop-off in work for the subjects when the abdominal ice pack was omitted from the rest period was 225 kg. M. and when ice was applied the mean drop-off was 69 kg. M. This difference is significant at the 1 per cent level of confidence. It was also observed that for the most part, the application of abdominal ice packs between bouts of strenuous exercise alleviated the symptoms of exhaustion such as dizziness, nausea and muscular weakness.

Comminuted Colles Fractures. C. K. Wier.

J. Kansas M. Soc. 50:60 (Feb.) 1949.

Fracture of the distal end of the radius is one of the most frequent bone injuries which the physician is required to treat. Following a comminuted fracture of the base of the radius, extensive hemorrhage and exudation occurs into all the adjacent structures, including the flexor and extensor tendons, carpal joint spaces, volar and extensor ligaments, fascia and subcutaneous tissue. This leads to extensive adhesions and a frozen, shiny, useless hand if the fingers are immobilized. A finger which is kept moving does not become stiff. Weeks of physical therapy will not compensate for three or four weeks of immobilization of the fingers — during which time the extensor tendons and lateral ligaments of the MCP and interphalangeal joints become shortened and contracted, making flexion of the fingers impossible. This can be prevented if the patient is allowed to be his own physical therapist and urged to move his fingers and thumb through their normal range many times daily. The patient should be seen frequently during the first two weeks so that the physician may be sure the active motion of the fingers is being carried out. Light work is encouraged. The shoulder should be moved through a complete range of motion several times daily to prevent an adhesive capsulitis and fixation of the shoulder in adduction. It does happen in the older group.

Therapeutic Possibilities of Microwaves: Experimental and Clinical Investigation. Khalil G. Wakim; J. F. Herrick; Gordon M. Martin, and Frank H. Krusen.

J. A. M. A. 139:989 (April 9) 1949.

In any discussion of microwaves certain questions arise that should be answered before final conclusions can be drawn: (1) What possible changes other than heating may result from exposure to microwaves? (2) How high may the temperatures of the deep tissues be raised without causing damage to the superficial tissues? (c)

Can deep tissues be damaged by microwave heating without the physician's or patient's being aware of destructive action? (4) Is the selective absorption of microwave radiations with resultant differences in heating of various tissues such as bone, the eyes, teeth, moist skin, dry skin, nerve trunks, edematous tissues, hematomas or abscesses? (5) What will be the result of applying microwaves over tissue containing metallic or other foreign objects?

Microwaves are apparently a safe, convenient and comfortable form of heating for local application to tissues. In both dogs and normal human beings microwave radiations will increase the circulation through the irradiated area. Microwave directors are not as yet available for heating very large areas of the body.

Microwaves may be contraindicated or at least should be used with caution over tissues with impaired circulation, over tissues with high fluid content, over regions containing metallic implants and over areas with hemorrhagic tendencies.

Much more careful investigative work must be done with microwave energy before its rightful place is certain in the field of physical medicine. Although investigations to date indicate that microwaves have considerable promise, clinically they should be used with caution and reservations.

Microwave Radiations. Current Comment.

J. A. M. A. **139**:926 (April 2) 1949.

Osborne and Frederick have studied the effects of microwave radiations on the living tissues and particularly on the eye. The radiations were formed by the Raytheon microtherm which generates energy in a continuous wave, air-cooled magnetron oscillator tube, the first generator of this type to be developed for the heating of human tissues. After exposure of thighs of dogs to high frequency energy, the maximum temperature was observed in the subcutaneous level and decreasing temperatures were found with increasing depths. In 7 "acute" experiments on dogs the eye was exposed to microwave radiations. Evidence of damage to the eyes or contiguous tissues did not appear. In twenty-four experiments on human subjects the thigh was exposed to microwave radiations. The treatments were comfortable to the patients and a minimum of erythema was noted. Worden and his associates report experiments on the temperatures of the skin, subcutaneous tissue, superficial muscle and deep muscle of the thigh of the dog after exposure to microwaves with the circulation intact and after ischemia produced by clamping the abdominal aorta. The temperature rises in the ischemic tissues were slightly higher than in normal tissues but were not considered significant after five or ten minutes of exposure, nor was there any evidence of burning after exposure for these shorter periods. After fifteen to twenty minutes of exposure the increased temperatures in ischemic tissues were considered significant with gross evidence of burning in most of the animals. The authors conclude that temperature tolerated by normal tissues cannot be regarded as the safe range of tolerance for ischemic tissues. Bony prominences were potential sites for formations of blebs. Richardson and his associates, utilizing the Raytheon microwave generator, produced cataractous lenticular opacities in rabbit eye after a direct single exposure. Until further data are accumulated, precaution should be observed in the use of microwaves in the region of the face and orbit.

Rehabilitation of the Hand. Arthur M. Pruce.

J. M. A. Georgia **38**:49 (Feb.) 1949.

Restoring useful function to a disabled hand that has been damaged by arthritis, trauma or paralysis is a medical problem of first importance. The social and economic implications of deformity and impaired function are obvious. The application of physical measures in rehabilitation of the hand must be guided by the reaction of the patient and the response of the hand. Massage is no substitute for active motion. With the exception of paralysis, passive movement of the fingers must be condemned. Early return to normal work procedures is the best type of occupational therapy.

Setting Up the Disabled. C. B. Heald.

Lancet **6545**:256 (Feb. 5) 1949.

More and more attention is nowadays being paid to the fate of the patient after he leaves hospital. Every investigation brings a similar group of facts to light. First, a high relapse-rate entails waste of beds, effort, and money, and the causes of relapse therefore deserve more thought. Secondly, the task of setting up the disabled, like the approach to positive health, is a study in itself. Thirdly, of the various groups into which the disabled fall, the home-bound are the least provided for and the most difficult to reestablish.

The author has chosen the term "setting up" deliberately. The dictionary defines the setter-up as "one who establishes," implying a positive act, by a new or definite process. This is an improvement on words beginning with "re," rehabilitation, reemployment, reinstatement, since these all signify a return to some former state. It is suggested that we get away from the idea that the disabled should always, or whenever possible, be pushed back to their former employment. Such reinstatement suits some, but only some. Setting up calls for a skilled study of the individual, his history, neighborhood, aptitudes and character, but above all his home. He must be freed from the notion that he must work back painfully and inefficiently to a former state; instead he must be established, enlivened and given security. Setting up is a special phase in his life, distinct from wellness or active illness. Properly used it should reduce the relapse-rate, ensure better coordination between responsible bodies, provide continuous care for the patient, speed the turnover in general hospitals, and encourage the pooling of

special knowledge. If more attention is paid to the home solving the problem of the home-bound will be helped.

Ultraviolet Exposure from Germicidal Lamps. George M. Hama.

Indust. Med. 18:75 (Feb.) 1949.

The use of ultraviolet germicidal lamps in food handling industries has become prevalent in the last few years. The lamps are usually the low pressure mercury type, emitting radiation in the region from approximately 2000 to 3000 Angstrom units, and producing their major output at 2537 Angstrom units. Ultraviolet radiations in this range have been found to exert a powerful bactericidal and fungicidal effect. For this reason, a number of food industries have adopted their use. The principal users are the meat industry, the baking industry, breweries, restaurants and eating places.

Proper installation of the lamps is essential to the control of exposures from germicidal lamps. It is desirable that each installation be supervised or inspected by competent persons versed in the technology of the subject and equipped with suitable means for measuring radiation intensities. Where lamps are installed for air sterilization, it is essential that the installation be made so that no one adjacent to the fixture in a normal position can see the lamp, either directly or by primary reflection from specular reflecting surfaces. In certain installations, unshielded lamps may be used if the time factor is small and the suggested limit of 5 microwatt hours per twenty-four is not exceeded. In walk-in coolers for meat storage, it is customary to mount unshielded lamps in the enclosures in order to accomplish a general irradiation.

Spectral Transmission of the Eye to Ultraviolet Radiations. V. Everett Kinsey.

Arch. Ophth. 39:508 (April) 1948.

Quantitative determinations of the absorption of ultraviolet radiations by different structures of the eye are of importance, since various pathologic conditions, such as cataract, retinal damage and functional visual disturbances, have been variously ascribed to these radiations. The measurements of absorption of ultraviolet radiations by ocular media made heretofore have been limited to photographing narrow bands of radiations transmitted through the eye. As pointed out by the author of one of these papers, the data obtained by this means are qualitative, since it is difficult to estimate the proportion of the radiations which is transmitted through the ocular structures. In the present study quantitative information was obtained by measuring photoelectrically the fraction of radiation which was transmitted.

The ultraviolet absorption spectrums of various components of the rabbit eye have been measured. The limit of transmission for the whole eye is approximately 330 millimicrons; that for the lens, 310 millimicrons, and that for the aqueous and vitreous humors and cornea, separately, approximately 280 millimicrons. Measurements of the absorption of ultraviolet radiations by the corneal epithelium indicate that the chief absorbing element is nucleoprotein, its limit of transmission being less than 230 millimicrons. The minimal amount of radiant energy from the sun to which the eye would have to be exposed before minimal damage would occur to the lens was calculated to be about three times the dose necessary to produce minimal damage to the cornea. The results suggest that so little ultraviolet radiation in the abiotic region reaches the retina that damage from these rays would be extremely unlikely.

Interpretation of the Electromyogram. D. Denny-Brown.

Arch. Neurol. & Psychiat. 61:99 (Feb.) 1949.

In renewing electromyographic investigations of human muscles after an interval, the author found that considerable differences of opinion have accumulated in regard to the interpretation of sveral electromyographic changes encountered in neurologic disorders. Since electromyography is in common use in some clinics and can provide useful diagnostic information, it may be of general interest to discuss critically some of the fundamental principles involved in the method.

Electromyography has valuable clinical uses and is a profitable field for further study. When used as an indicator of the neuronal activity in disease processes, it should be controlled by critical appraisal of the mechanical contractile activity in the muscle concerned, for the electrical field of motor units is large and grows more extensive in proportion to the intensity of discharge. Spread of rhythms to two or more sets of leads is particularly liable to occur from large units, particularly in atrophic muscle. Few types of change are specific for types of nervous disorder, and the physiologic reasons for this are discussed.

Combined Coromine-Electroshock Therapy in the Treatment of Psychotic Excitement. Howard D. Fabing.

Am. J. Psychiat. 105:435 (Dec.) 1948.

This report deals with 100 consecutive patients who have been treated by a new method of shock therapy on the neuropsychiatric service at The Christ Hospital, Cincinnati. In this technic the application of electroshock is preceded by the intravenous administration of 5 cc. coramine. The method is a means of terminating states of psychotic excitement more rapidly and more effectively than when electroshock alone has been employed.

The method has also proved of value in acute confusional excitement, excitement with severe agitated melancholia, paranoid excitement, excitement with schizo-affective states and in selected cases of intractable severe anxiety.

It is assumed that the theoretical basis of this combined therapeutic method is as follows: Coramine, an analeptic drug, excites the higher levels of the nervous system chemically; the electroshock stimulus excites these structures electrical-

ly. The simultaneous application of both these stimuli produces an excessive, or ultramaximal, stimulus as defined by Pavlov, and the result is the ultra-paradoxical state of cortical inhibition, with consequent abolition of the clinical symptoms of excitment. The method has been of value in handling excited patients on an open psychiatric ward in a general hospital and in terminating these illnesses more rapidly.

Occupational Therapy. Lawrence F. Woolley.

Am. J. Psychiat. **105**:536 (Jan.) 1949.

Occupational therapy has kept pace with other phases of psychiatric treatment in expanding facilities, increasing personnel and presenting more adequate and varied programs for therapy in psychiatric hospitals. Units to provide occupational therapy facilities in general hospitals have been opened, and, although many of these are still quite new, it is obvious that there will be increasing recognition of the value of occupational therapy as an adjunct to treatment of all phases of physical and emotional illness. There were, in this country before the war, 9 schools offering training in occupational therapy; now there are more than 20. Schools have been opened in Australia, Czechoslovakia and India by American personnel. Other countries are contemplating establishing schools. The rehabilitation programs both through the Federal and State Governments and the Veterans Administration have continued to expand and are helping more persons with psychiatric disabilities. There is still a great shortage of trained therapists.

Medical Aspects of Chronic Joint Disease. Elbert L. Persons.

Nebraska M. J. **34**:90 (March) 1949.

In rheumatoid arthritis and fibrositis one is dealing with inflammatory conditions of unknown cause for which no specific treatment is available. Remissions and even apparent cures are frequent, occurring for reasons which are not known. There must be, somewhere in the human body, a strong factor of resistance to this type of inflammation, present to marked degree in many individuals, since the majority of cases run a prolonged course and fulminating cases of true rheumatoid disease are uncommon. The only rational approach is a positive one of attempting to remove all burdens which can be found. Pain is the foremost of these and orthopedic and physical therapy measures and drugs are of great importance. Foci of infection should be removed if they seem to be definite and significant, but occupational, environmental and psychologic burdens, including fear of incapacity and dependency should never be overlooked.

The use of gold is still controversial. There is no evidence that it can be used as a substitute for the more thorough approach which is suggested here. Routines of treatment based on unproven hypotheses should be avoided. The separation of other clinical entities from the group of arthritic diseases is a valuable forward step, and a simple standard classification is helpful in planning treatment for the individual case. The greatest simple problem is in the nature of the inflammatory process involved in rheumatoid disease and of the factor of resistance in the human organism which is responsible for remissions and chronicity.

Vocational Rehabilitation of Epileptics in Texas. John L. Otto.

Am. J. Psychiat. **105**:417 (Dec.) 1948.

Those associated with vocational rehabilitation have long realized that epileptics should be included in any state-wide program designed to aid the handicapped, feeling that many of these patients who were serious economic burdens to their families or the state could become self-supporting with the proper help. Education of employers and employment agencies, proper selection of jobs, adequate medical control of the seizure and the cooperation of the local physician are essential before successful rehabilitation of the epileptic can be expected.

Radioisotopes in Medicine. George M. Lyon.

Mil. Surg. **104**:171 (March) 1949.

In 1923, Hevesy, a Danish scientist, was the first to employ a radioisotope in a biological investigation. He used radiolead (radium D) to study the metabolism of lead in plants. He was able to detect the radiolead by determining its radio-activity. This method was at least a million times more sensitive than ordinary chemical or physical methods then available. It had the advantage of permitting a metabolic study of lead in quantities that were so small as to be non-toxic to the individual organism. Similar study was later made with radio-bismuth (Radium E).

The Role of the Shahan Thermophore in Ophthalmic Therapeutics. M. Hayward Post.

Am. J. Ophth. **32**:215 (Feb.) 1949.

The apparatus, now known as the Shahan thermophore, was invented by Dr. W. E. Shahan in an effort to place the local applications of heat to the various lesions of the eye upon a more scientific basis. His first paper concerning this instrument appeared in 1916. The Shahan thermophore is an instrument of immense value in ocular therapy, when properly used, and should be thoroughly understood by every well-informed ophthalmologist. By means of this instrument, the first scientific study of the effects of varying degrees of heat upon the ocular tissues and upon a number of bacteria and viruses invading them, has been made possible. Temperatures up to 145 F., applied for one minute, do no permanent injury to normal ocular tissues, nor do they result in persistent clouding of the cornea. Temperatures of 158 F. do result in permanent changes in the substantia propria of the cornea, but such temperatures are only necessary in the most severe types of lesions, such as those resulting from the action of the tubercle bacillus.

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Hospitals, 34; Assistant Residencies and Residencies, 70

Name of Hospital	Location	Chief of Service	Patients Treated	Number of Treatments	Asst. Res. and Residencies Offered[a]	Beginning of Service (1948)	Length of Service Offered (Years)	Beginning Stipend (Months)
United States Army								
†Letterman General Hospital★	San Francisco	A. V. Bateman	5,994	285,400	2	1/1	1–3	m
†Fitzsimons General Hospital★	Denver	J. H. Kuitert	2,506	119,005	2	1/1	1–3	m
Walter Reed General Hospital★	Washington, D. C.	E. M. Smith	8,673	238,036	3	1/1	1–3	m
†Percy Jones General Hospital★	Battle Creek, Mich.	A. E. White	28,849	346,505	2	.....	1–3	m
Veterans Administration								
Veterans Admin. Hospital	Chamblee, Ga.	W. Steiner	.....	20,400	1	7/1	1+	$275.00
†Veterans Admin. Hospital	Hines, Ill.	L. Newman	37,369	482,960	7	.....	1–3	275.00
Veterans Admin. Hospital	Framingham, Mass.	F. Friedland	10,130	194,794	2	7/1	1–2	275.00
†Veterans Admin. Hospital	Jefferson Barracks, Mo.	F. Ewerhardt	2,589	71,974	2	7/1	1+	275.00
†Veterans Admin. Hospital	New York City	H. Kessler	21,729	287,884	3	1/1, 7/1	1–3	275.00
†Veterans Admin. Hospital	Portland, Ore.	E. W. Fowlks	3,230	65,750	1	7/1	1–3	275.00
Nonfederal								
†Los Angeles County Hospital★[4]	Los Angeles	O. Huddleston	.....	14,633	2	Varies	2	.....
†White Memorial Hospital★	Los Angeles	F. B. Moor	500b	20,000b	1	7/1	1–3	147.33
Stanford University Hospital★[4]	San Francisco	W. H. Northway	.....	6,561	2	7/1	1–2	50.00
†University of California Hospital★†	San Francisco	F. Baker	.....	7,123b	1	7/1	1	50.00
University Colorado Medical Center								
†Colorado General Hospital★[4]	Denver	H. Dinken	2,905	64,050	1	Varies	1–3	75.00
†Emory University Hospital★	Emory Univ., Ga.	R. L. Bennett	7,836	.....	1	.....	1–3	.....
†Georgia Warm Springs Foundation	Warm Springs, Ga.	R. L. Bennett	.....	84,000	1	.....	1–3	.....
Michael Reese Hospital★[4]	Chicago	C. O. Molander	1,534	16,282	2	7/1	1	25.00
Passavant Memorial Hospital★[4]	Chicago	J. S. Coulter	7,784b	12,696b	2h	.....	1	.....
University of Kansas Hospital★	Kansas City, Kan.	Donald L. Rose	2,775	25,347	3	.....	1½	.....
†Massachusetts General Hospital★	Boston	A. L. Watkins	1,639b	16,265b	2	.....	1–3	41.67
†University Hospitals★[4]	Minneapolis	M. Knapp	7,677	12,141	2	7/1	1–3	115.00
Mayo Foundation	Rochester, Minn.	F. H. Krusen	.....	**	6	.....	3	.....
†Bellevue Hospital, Div. III—N. Y. Univ.★	New York City	H. A. Rusk	.....	.....	7	Varies	1	70.00
†Goldwater Memorial Hospital★[4]	New York City	H. Behrend	872	53,738	1	.....	1	120.00
†Hospital for Joint Diseases★[4]	New York City	J. Weiss	78,386	91,746	2	1/1	1+	40.00
†Montifiore Hospital for Chronic Diseases★	New York City	K. Harpuder	.....	.....	1	.....	1+	50.00
†Mount Sinai Hospital★[4]	New York City	.....	7,310	9,920	1	1/1, 7/1	1	50.00
†Presbyterian Hospital★[4]	New York City	W. B. Snow	77,771	221,144	1	.....	1	41.66
St. Luke's Hospital★	New York City	R. Muller	2,123	104,604	1	Varies	1	50.00
†Cleveland Clinic Foundation Hospital	Cleveland	W. J. Zeiter	16,257	39,919	1	7/1	1–3	100.00
†Hospital of the Univ. of Pennsylvania★[4]	Philadelphia	G. M. Piersol	1,078	12,883	1	Varies	1	.....
†Medical College of Virginia, Hosp. Div.★	Richmond, Va.	.....	2,063	32,512	1	.....	1	46.50
†State of Wisconsin General Hospital★[4]	Madison, Wis.	H. D. Bouman	3,050	28,382	2	7/1	3	25.00

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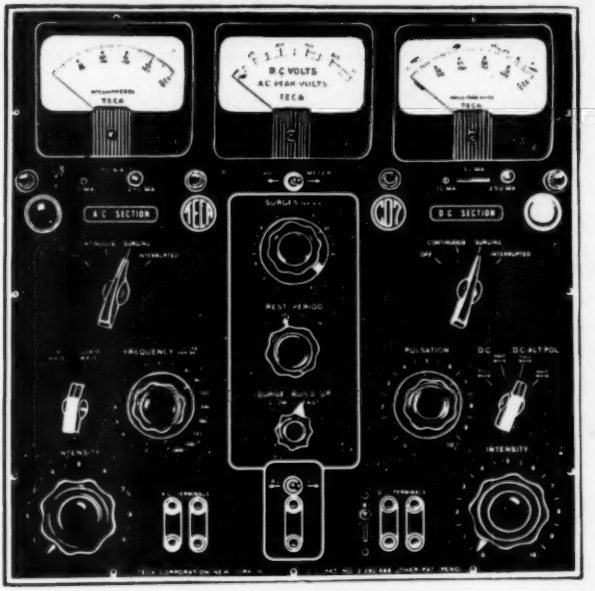

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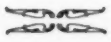

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